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THE ANATOMY OF THE HUMAN BONES, NERVES, AND LACTEAL SAC and DUCT.

The EIGHT EDITION.

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TO THE

STUDENTS of ANATOMY

IN THE

University of EDINBURGH.

GENTLEMEN,

WHEN this *Osteology* was first printed in 1726, I did not know that Albinus, Winslow, and Palfyn, were to publish descriptions of the bones; otherwise my papers probably would have remained yet undelivered to the printers. I however flatter myself, that this *essay* has been of use to the gentlemen who did me the honour to attend my lectures, by assisting them to understand my sense and representation of things in this fundamental part of anatomy; and that it has possibly been of more advantage to them than a more compleat work from an abler hand, unless my demonstrations had been in the order and method of such an author.

 This

This view of your improvement, Gentlemen, is a prevailing argument with me to cauſe this eſſay to be reprinted; and you cannot reaſonably blame me, if I likewiſe acknowledge another motive for it, which more particularly relates to myſelf. In a new edition an author has an opportunity of making his works more correct, compleat, and conſequently acceptable to the public, who may perhaps be indulgent enough to think this little treatiſe not altogether uſeleſs; ſince more reaſoning on the ſtructure and morbid *phænomena* of bones is to be found in it, than in the other writers, who have confined themſelves almoſt entirely to the deſcriptive or proper anatomical part of the *oſteology*.

I have here kept to the plan of the former editions, by firſt conſidering, in the order that ſeemed to me moſt natural and methodical, every thing which I thought neceſſary to be known concerning bones in general; and, in the ſecond part, I have deſcribed the ſeveral bones compoſing the ſkeleton.

The bones of adults are what I principally endeavour to deſcribe; but I have added as much of the *oſteogenea* as I think ſervice-

ſerviceable in the practice of phyſic and ſurgery.

That little might be omitted of what was formerly done on this ſubject, I have taken all the aſſiſtance I could from books; but have never aſſerted any anatomical fact on their authority, without conſulting nature, from which all the deſcriptions are made; and therefore the quotations from ſuch books ſerve only to do juſtice to the authors, who have remarked any thing in the ſtructure of the parts that was commonly omitted, and to initiate you in the hiſtory of anatomy; which I once propoſed to make complete, ſo far as related to this ſubject: But not being able to procure ſeveral books, and being ſenſible how many more may have never come to my knowledge, I laid aſide this deſign; of purpoſe omitted many I could have inſerted, and in ſome places I have changed an older author for a later one, who has more fully or clearly deſcribed what I treated of. Beſide anatomiſts, I have alſo named ſeveral other authors to confirm my reaſoning by practical caſes; of which it is not to be ſuppoſed my own experience could furniſh a ſufficient variety.

You will readily obſerve, that I quote no paſſages with a view to criticiſe or condemn them. This precaution of giving no offence, is very neceſſary in thoſe whoſe are ſufficiently conſcious of their being liable to lay themſelves open to juſt cenſure: and it prevents occaſions of uſeleſs wrangling, in which generally both parties are loſers, and the public has little advantage.

In this treatiſe I always make uſe of the moſt common name of each part, and have put the ſynonimous names to be met with in books at the foot of the page, that the reading might be ſmoother, and you might conſult them at your leiſure to aſſiſt you in underſtanding different authors.

The deſcriptions and reaſoning are here blended, without which I always find young anatomiſts are ſoon diſguſted with authors: Their imaginations cannot follow a long chain of deſcriptions, eſpecially when they are not taught at the ſame time the uſes which the deſcribed parts ſerve: Their minds muſt have ſome relaxation, by a mixture of reaſoning, which never miſſes to ſtrike the fancy agreeably, and

raiſes

raiſes a ſtrong deſire to underſtand the principles on which it depends.

The *phænomena* of diſeaſes are all deduced in this eſſay from the ſtructure of the parts, by way of corollaries and queſtions; which ſuch an anatomical work confined me to. And this method has otherwiſe a good effect: For, when one meets with an uſeful propoſition, and is obliged to employ a little thought to find out its ſolution, the impreſſion it makes is deeper, and he acquires a fondneſs for it, as being in part his own diſcovery. My pupils have frequently aſſured me, that they could, with very ſmall reflection, trace out the whole reaſoning from which my concluſions were drawn; I hope their ſucceſſors will alſo think this an agreeable manner of being inſtructed.

Thoſe gentlemen who deſired I would add the lectures which I pronounce in my colleges as a commentary upon the text, where the diſeaſes are mentioned, will, I perſuade myſelf, excuſe me for not complying with their deſire, when they conſider the deſign of this is to be a ſchool-book, and how great the difference is between inſtructing youth in private, and pretending to inform the public. *Art.* xxiv.

xxiv. vol. v. of Medical Eſſays and Obſervations, publiſhed in this place, is one of theſe lectures which I gave as a commentary on the paragraph (*p.* 12.) concerning the different kinds of *caries*.

In this edition, I have corrected the miſtakes and obſcure paſſages which I diſcovered in the former, and in ſome places, I have made the deſcriptions more full and exact, aiming all I could to ſhun unneceſſary minuteneſs on the one hand, and a blameable inaccuracy on the other: Whether I have hit that juſt medium, is what you and the public muſt now judge.

I am ſtill of opinion, that figures of the bones would at any rate have been unneceſſary in a book that is intended to be illuſtrated and explained by the originals themſelves; but would be much more ſo now, when my late ingenious friend Mr Cheſelden, Dr Albinus, and Mr Sue (*a*), have publiſhed ſuch elegant ones.

You have advantageous opportunities in this place of ſtudying all parts of medicine, under the profeſſors of its different branches

(*a*) Traite d'oſteologie, traduit de l'Anglois de M. Monro, ſeconde partie.

branches in the Univerſity, and of ſeeing the practice of pharmacy, ſurgery, and phyſic, with our ſurgeon-apothecaries, and in the Royal Infirmary, where the diſeaſed poor are carefully treated. Theſe your intereſt, and, I hope, your inclinations, will lead you, Gentlemen, ſo to improve, as that they may become the happy means of your making a conſiderable figure in your ſeveral ſtations. Whatever aſſiſtance is in my power towards ſuch a deſireable event, ſhall be given with the greateſt pleaſure by

Your humble ſervant.

ALEXR. MONRO.

THE

ANATOMY

OF THE

HUMAN BONES.

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PART I.

Of the BONES in general.

BONES are covered by a membrane, named on that account PERIOSTEUM*, which is ſo neceſſary to them, that we muſt examine its texture and uſes, before we can underſtand their ſtructure.

The *perioſteum*, as well as moſt other membranes, can be divided into *layers* of fibres. The *exterior* ones, compoſed of the fibres of the muſcles connected to the bones, vary in their number, ſize, and direction, and conſequently occaſion a very great difference in the thickneſs and ſtrength of the *perioſteum* of different bones, and even of the different parts of the ſame bone. The *internal* layer is every

 where

* Membrana circumoſſalis, omentum oſſibus impoſitum.

where nearly of a similar structure, and has its fibres in the same direction with those of the bone to which they are contiguous. Ought not then the name *periosteum* to be applied, strictly speaking, only to this internal layer, to which the others are joined in an uncertain manner and number?

Some authors *(a)* endeavour to prove the internal layer of fibres of the *periosteum* to be derived from the *dura mater:* For, say they, since the membrane covering the scull is plainly a production or continuation of the *dura mater*, which passes out between the sutures; and since there are muscles on the head, as well as in other parts, which might furnish a *periosteum*, it is needless to assign different origins to membranes which have the same texture and uses. They add further, in proof of this doctrine, that the *periosteum* extends itself along the ligaments of the articulations from one bone to another; and therefore is continued from its origin over all the bones of the body.—While anatomists were fond of the hypothesis of all membranes being derived from one or other of the two that cover the brain, a dispute of this kind might be thought of consequence: But now that the hypothesis is neglected as useless, it is needless to examine the arguments for or against it.

Except where muscles, cartilages, or ligaments are inserted into the *periosteum*, its external surface is connected to the surrounding parts by thin cellular membranes, which can easily be stretched considerably, but shorten themselves whenever the stretching force is removed.

(a) Havers, Osteolog. nov. disc. 1. p. 16.

moved. When these membranes are cut off or broken, they collapse into such a small space, that the surface of the *periosteum* seems smooth and equal.

When we attempt to tear off the *periosteum* from bones, we see a great number of white threads produced from the membrane into them; and, after a successful injection of the arteries with a red liquor, numerous vessels are not only seen on the *periosteum* (*a*), but most of the fibres sent from the membrane to the bone, shew themselves to be vessels entering it, with the injected liquor in them; and when they are broken, by tearing off the *periosteum*, the surface of the bone is almost covered with red points.

The veins corresponding to these arteries are sometimes to be seen in subjects that die with their vessels full of blood; though such numerous ramifications of them, as of the arteries, can seldom be demonstrated, because few of them naturally contain coloured liquors, and such liquors can difficultly be injected into them. This however is sometimes done (*b*).

The great sensibility of the *periosteum* in the deep-seated species of *paronychia*, in *exostoses*, *nodi*, *tophi*, and *gummata*, from a *lues venerea*, or whenever this membrane is in an inflamed state, is a sufficient proof that it is well provided with nerves, tho' they are perhaps too small to be traced upon it; and therefore one

(*a*) Ruysch. Epist. 5. tab. 5. fig. 1. 2. epist. 8. tab. 9. fig. 1, 9.

(*b*) Sue traité d'osteologie, traduit de l'Anglois de Mr Monro. Note in page 9.

cannot well determine, whether they are ſent along with the arteries in the common way, or are derived from the tendinous fibres of the muſcles expanded on the *perioſteum* (*a*).

Veſſels alſo paſs through the *perioſteum* to the marrow; of which more hereafter. And frequently muſcles, ligaments, or cartilages, pierce through the *perioſteum*, to be inſerted into the bones.

The chief uſes of the *perioſteum* are: 1. To allow the muſcles, when they contract or are ſtretched, to move and ſlide eaſily upon the bones; the ſmooth ſurface of this membrane preventing any ill effects of their friction upon each other. 2. To keep in due order, and to ſupport the veſſels in their paſſage to the bones. 3. By being firmly braced on the bones, to aſſiſt in ſetting limits to their increaſe, and to check their overgrowth. 4. To ſtrengthen the conjunction of the bones with their *epiphyſes*, ligaments, and cartilages, which are eaſily ſeparated in young creatures, when this membrane is taken away. 5. To afford convenient origin and inſertion to ſeveral muſcles which are fixed to this membrane. And, laſtly, to warn us when any injury is offered to the parts it covers; which, being inſenſible, might otherwiſe be deſtroyed without our knowledge, or endeavouring to procure a remedy.

When

(*a*) *See* the diſpute about the ſenſibility of this and of other membranes in Zimmerman. Diſſert. de irritabilit. —Act Gotting. vol. 2. —Haller Sur la nature ſenſible et irritable.—Whytt's phyſiolog. eſſay II.—Remar. Diſſert. de fungo articulor. § 26. 34.

When the cellular substance connecting the *periosteum* to the surrounding parts is destroyed, these parts are fixed to that membrane, and lose the sliding motion they had upon it; as we see daily in issues, or any other tedious suppurations near a bone.—When the vessels which go from the *periosteum* to the bones are broken or eroded, a collection of liquor is made between them, which produces a sordid ulcer or rotten bone. This often is the case after fractures of bones, and inflammations of the *periosteum*, or after *small pox*, *measles*, *spotted fevers*, and *erysipelas*.—Do not the disorders of the *periosteum*, coming rather along with, or soon after the cutaneous than other diseases, indicate some similarity of structure in the *periosteum* and skin.

The BONES are the most hard and solid parts of the body, and, as all other parts where large vessels do not enter, are generally of a white colour; only in a living creature they are blueish, which is owing to the blood in the small vessels under their surface. The less therefore and fewer the vessels are, and the thicker and firmer the bony surface covering the vessels is, the bones are whiter. Hence the bones of adults are whiter than those of children; and, in both young and old, the white colour of different bones, or of the several parts of the same bone, is always in proportion to their vessels and solidities; which circumstances ought to be regarded by surgeons, when they are to judge of the condition of bones laid bare.

Bones are compoſed of a great many *plates**, each of which is made up of fibres or ſtrings united by ſmaller fibrils (*a*); which being irregularly diſpoſed, and interwoven with the other larger fibres, make a reticular work.—This texture is plainly ſeen in the bones of fœtuſes, which have not their parts cloſely compacted, and in the bones of adults which have been burnt, long expoſed to the weather, or whoſe compoſition has been made looſe by diſeaſes.—The chinks which are generally made according to the direction of the larger fibres of bones that have undergone the action of fire, or of the weather, ſhew the greater ſtrength of theſe than of the fibres which connect them.—Numerous accurate obſervations of the different times in which exfoliations are made from the ſides or ends of ſimilar bones, might bid fair to determine what is the proportional force of coheſion in the two ſorts of fibres.

The plates are ſaid (*b*) to be firmly joined to each other by a great number of *claviculi*, or ſmall bony proceſſes, which, riſing from the inner plates, pierce thro' ſome, and are fixed into the more external ones. Of theſe nails, four kinds, *viz. the perpendicular*, *oblique*, *headed*, and *crooked*, have been deſcribed: But in bones fitly prepared, I could only ſee numerous irregular proceſſes riſing out from the plates (*c*).

Though the exterior part of bones is compoſed of firm compact plates, yet they are all more

* Squamæ, bracteæ, laminæ.

(*a*) Malpigh, Anat. plant. et oper. poſthum.

(*b*) Gagliard. Anat. oſſium. nov. invent. illuſtrat. cap. 1. abſ. 2.

(*c*) Malpigh, oper. poſthum.

more or leſs cavernous internally. In ſome (*e. g.* middle thin part of the *ſcapula* and *os ilium*) the ſolid ſides are brought ſo near, that little cavity can be ſeen; and in others (middle of *os humeri*, *femoris*, &c.) the cavities are ſo large, that ſuch bones are generally eſteemed to be hollow or fiſtular. But the internal ſpongy texture is evident in young animals; and ſome of it may be ſeen to remain in thoſe of greateſt age, when bones are cautiouſly opened after they have been kept ſo long as to be free of the oil they contain, or after being burnt.

This ſpongy cavernous internal part of bones, is generally called their *cancelli* or LATTICE-WORK, and is formed in the following manner. The plates are firmly joined about the middle of the bone: but as they are extended towards its ends, the more internal plates ſeparate from the exterior, and ſtretch out their fibres towards the axis of the bone, where they are interwoven with the fibres of other plates that have been ſent off in the ſame way. Seeing the plates are thus conſtantly going off, the ſolid ſides of the bones muſt become thinner, and the lattice-work muſt be thicker and ſtronger towards their ends. This is evident in many of them, where the ſolid ſides of their middle are very thick, and the *cancelli* are ſcarce obſervable; whereas, at the ends, where their diameter is greateſt, the ſolid walls or ſides are not thicker than paper, and the *cancelli* are numerous and large enough to fill up the whole ſpace left between the ſides.

The twiſting and windings whch theſe *cancelli* make, and the interſtices which they leave, differ

differ considerably in figure, number, and size; and therefore form little cells, which are as different, but communicate with each other. Some writers (*a*) minutely remark these different appearances of the *cancelli*, after they begin to separate from the plates; and from thence distinguish them into *wrinkled*, *perforated*, and *net-like*.

The *cancelli* sustain the membranous bags of the marrow which are stretched upon them, and thereby hinder these membranous parts to be torn or removed out of their proper places, in the violent motions and different postures which the bones are employed in. This Support which the *cancelli* afford the marrow, also saves its membranes and vessels, in the lower parts of the bones, from being compressed by the weight of the marrow above.

The depressions between the fibres of the external plates of bones appear like so many furrows on their surface, into each of which the *periosteum* enters; by which the surface of contact, consequently the cohesion, between it and the bone, is considerably increased, and a greater number of vessels is sent from it into the bone, than if it was a plain surface.

Both on the ridges and furrows, numerous little pits or orifices of canals are to be seen, by which the vessels pass to and from the bones.

After a successful injection, the arteries can be traced in their course from the pits to the plates and fibres; and, in sawing, cutting, or rasping the bones of living creatures, these vessels discover themselves, by the small drops of blood

(*a*) Gagliar. Anat. ossium, cap. 1. obs. 4, 5, 6, 7.

blood which then ouze out from the moſt ſolid part of the bones. But the cleareſt demonſtration of the intimate diſtribution of theſe ſmall arteries, is to obſerve the effect of ſuch a tinging ſubſtance as can retain its colour, when ſwallowed, digeſted, and mixed with the blood of any living animal, and at the ſame time has particles ſmall enough to be conveyed into the veſſels of the bones; ſuch is *rubia tinctorum*, madder root (*a*): For we ſee the gradual advances which this tincture makes from the *perioſteum* into the more internal parts of the bones, and how univerſally the diſtribution of the liquors is made, the whole bony ſubſtance being tinged. Whether the time in which this tinged liquor paſſes from the outer to the internal plates, till all the plates are made of its colour, and the time which the diſappearing of the dye, after giving the creature no more of this ſort of food, makes us think it takes to return, are the ſame in which the natural liquors circulate, is uncertain; becauſe this tinging ſubſtance may move more ſlowly, or may paſs more quickly, than the natural liquors do. —The arteries are larger near each end than at the middle of the large bones that are much moved; becauſe they not only ſerve the bony plates near the ends, but paſs through them to the marrow.—As animals advance in age, the arteries of the bones become leſs capacious; as is evident, 1. From the bones of adults having leſs blood in them than thoſe of children have. 2. From

(*a*) Philoſoph. tranſact. num. 442, art. 8. num. 443. art. 2. num. 457. art. 4.—Mem. de l'Acad. des ſciences, 1739, 1742.

2. From many of them becoming incapable in old age of admitting the coloured powders uſed in injections, which eaſily paſs in youth. And, 3. From the bones of old creatures being more difficultly tinged with madder than thoſe of young ones.—If authors have not miſtaken, the arteries of bones have ſometimes become very large (*a*).

We may conclude from arteries being accompanied with veins ſo far as we can trace them in every other part of the body, that there are alſo veins in the bones; and the diſappearing of the tincture of *madder*, after bones of living animals are coloured with it, could not be without ſuch veins to carry it away; nay, the veins of bones can ſometimes be injected and then ſeen (*b*).

The bones of a living animal are ſo inſenſible, that they can be cut, raſped, or burnt, without putting the creature to pain, and the nerves diſtributed in their ſubſtance cannot be ſhewn by diſſection; from which it might be inferred that they have no nerves diſtributed to them: But the general tenor of nature, which beſtows nerves to all the other parts, ſhould prevent our drawing ſuch a concluſion. And if ſenſibility is a ſure proof of nerves entering into the compoſition of any part, as it is generally allowed to be, we have ſufficient evidence of nerves here in the bones; for the granulated red fleſh which ſprouts out from them, after an amputation of a limb, or performing the operation

(*a*) Diemerbrock. Anat. lib. 9. cap. 1.——Mery. Hiſt. de l'Acad. des ſciences, 1704.

(*b*) Sue trad. d'oſteolog. p. 9.

operation of the *trepan*, or after an *exfoliation*, is exquisitely sensible: And, in some ulcers of bones, where the *periosteum* was all separated, the patient suffered racking pain, if the bone was touched with a rough instrument; nor was he free of pain after the bone was perforated (*a*)—The reason why the nerves of rigid hard bones become insensible, is, That all nerves must have a considerable degree of flexibility at the part where objects are applied, otherwise it cannot be affected by their impressions. We see this illustrated in a very common analogous case, the growth of a new nail: When the former one has suppurated off, the thin membrane which first appears, is exquisitely sensible; but gradually becomes dull in its sensation, till it can be cut or scraped, without causing pain, after it is formed into a hard nail.

From what has been said of the vessels of bones, it is evident, that there is a constant circulation of fluids in every part of them; and that there is a perpetual waste and renewal of the particles which compose the solid fibres of bones, as well as of other parts of the body; the addition from the fluids exceeding the waste during the growth of the bones; the renewal and waste keeping pretty near *par* in adult middle age; and the waste exceeding the supply from the liquors in old age; as is demonstrable from their weight: For each bone increases in weight, as a person approaches to maturity; continues of nearly the same weight till old age begins, and then becomes lighter. —The specific gravity of the solid sides, on the

(*a*) Nicol. Massa. lib. introd. anat. cap. 30.

the contrary, increaſes by age; for then they become more hard, compact, and denſe. In conſequence of this, the bones of old people are thinner and firmer in their ſides, and have larger cavities than thoſe of young perſons.

The vaſcular texture of bones muſt make them ſubject to *obſtructions*, *ecchymoſes*, *ulcers*, *gangrenes*, and moſt other diſeaſes which the ſofter parts are affected with; and therefore there may be a greater variety of *caries* than is commonly deſcribed (*a*).

Hence we can account for the following appearances.

Hæmorrhages from fungous fleſh riſing out from the moſt ſolid part of a cut bone (*b*).

The regular alternate elevation and ſubſiding, or apparent pulſation, frequently to be ſeen in ſome of the cells of a carious bone.

Cells reſembling *cancelli*, ſometimes ſeen in the part of a bone, which, in a natural ſtate, is the moſt ſolid and firm (*c*).

A bone as a tube including another bone within it (*d*).

On the internal ſurface of the ſolid parts of bones, there are orifices of canals, which paſs outwards through the plates to open into other canals that are in a longitudinal direction, from which other *tranſverſe* paſſages go out to terminate in other *longitudinal* canals; and this ſtructure is continued through the whole ſubſtance of bones, both theſe kinds of canals becoming ſmaller

(*a*) Edinburgh Medical eſſays and obſ. vol. 5. art. 25.
(*b*) Medical eſſays, vol. 4. art. 21.
(*c*) Ruyſch. Theſ. 8. num. 8. Theſ. 10. num. 176.
(*d*) Idem, ibid.

smaller gradually as they approach the outer surface (*a*).—These canals are to be seen to the best advantage in a bone burnt till it is white: When it is broken transversely, the orifices of the *longitudinal* canals are in view; and when we separate the plates, the *transverse* ones are to be observed. Here however we are in danger of believing both these sorts of canals more numerous than they really are; because the holes made by the processes connecting the plates of bones, have the appearance of the *transverse* (*b*), and the passages for the blood-vessels resemble the *longitudinal* canals. I do not know how we are to keep free of error about the *transverse* canals; but think we may distinguish between the two kinds of *longitudinal* ones; for the passages of the vessels are largest near the external surface of the bone, and every transverse section of them is circular; whereas the *longitudinal canals* are largest near the *cancelli*, and their transverse sections appear to me of a flat oval figure, which may be owing to the different *momentum* of the fluids conveyed in them.—The situation of the larger longitudinal canals, and of the passages of the larger vessels, make a bone appear more dense and compact in the middle of its solid sides, than towards its outer and inner surfaces, where it is spongy.

We see marrow contained in the larger transverse and longitudinal canals just now described, and from thence judge that it passes

(*a*) Havers Osteolog. nov. p. 43.
(*b*) Morgagn. Advers. 2. animad. 25.

alſo into the ſmaller ones. The drops of oil which we diſcover with a microſcope every where on the ſurface of a recent bone, fractured tranſverſely, and the owſing of oil through the moſt ſolid bones of a ſkeleton, which renders them greaſy and yellow, are a confirmation of the uſe of theſe canals. Of what advantage this diſtribution of the marrow thro' the ſubance of bones is, will be mentioned when the nature and uſe of this animal oil is inquired into.

Moſt bones have one or more large oblique canals formed through their ſides for the paſſage of the medullary veſſels, which are to be deſcribed afterwards.

Bones expoſed to a ſtrong fire in chemical veſſels, are reſolved, in the ſame manner as the other parts of animals, into *phlegm*, *ſpirit*, *volatile ſalt*, *fetid oil*, and a black *caput mortuum*. But the proportion of theſe principles varies according to the age, ſolidities, and other circumſtances of bones. Young bones yield the largeſt proportion of *phlegm*; ſpongy bones afford moſt *oil*, and ſolid ones give moſt ſalt and black *reſiduum*.——Though this *reſiduum* can ſcarce be changed by the force of fire while it is in cloſe veſſels; yet, when it is burnt in an open fire, the tenacious oil, to which it owes its black colour, is forced away, and a white earth is left that has little or no fixed ſalt in it. This earth ſeems to be the proper conſtituent ſolid part of bones, and the other principles give it firmneſs and tenacity: For the quantity of the earth is ſo great, that, after all the other principles

principles are separated from a bone, its former shape and size remain (*a*); but it is very brittle till it is moistened with water or oil, when it recovers some tenacity.——The increase of the proportion of earth in old people's bones is one reason of their being more brittle than those of young people are.

Lest any imagine the salts and oils of bones, while in a natural state, to be of the same acrid kind with those obtained from them by the chemical analysis, it is to be observed, that these principles may be extracted from bones in the form of a very mild jelly, by boiling them in water.

The bones sustain and defend the other parts of the body.

Bones are lined within, as well as covered externally, with a membrane; which is therefore commonly called PERIOSTEUM INTERNUM.

The *internal periosteum* is an extremely fine membrane; nay, frequently it has a loose reticular texture; and therefore it is compared by some to the *arachnoid* coat of the spinal marrow: so that we cannot expect to divide it into layers as we can divide the *external periosteum*. We can however observe its processes entering into the transverse pores of the bones, where probably they are continued to form the immediate canals for the marrow distributed through the substance of the bones; and along with them vessels are sent, as from the external *periosteum*, into the bone (*b*). These processes being of a very delicate texture, the adhesion

(*a*) Havers Osteolog. nov. disc. 1. p. 32.
(*b*) Winslow Exposition anat. des os frais, § 82. 83.

of this membrane to the bone is so small, that it separates commonly more easily from the bone than from the marrow which it contains: Wherefore, one might call it the common membrane of the marrow, rather than by the name it now has. But whether one or the other designation ought to be given it, is not worthy a dispute.

From the internal surface of the internal *periosteum*, a great number of thin membranes are produced; which, passing a-cross the cavity, unite with others of the same kind, and form so many distinct bags, which communicate with each other; and these again are subdivided into communicating vesicular cells, in which the marrow is contained. Hence it is, that the marrow, when hardened, and viewed with a microscope, appears like a cluster of small pearl; and that the hardened marrow of bones buried long under ground, or laid some time in water, and then dried, is granulous (*a*). This texture is much the same with what obtains in the other cellular parts of the body, where fat is collected; only that the cells containing the marrow are smaller than those of the *tunica adiposa* or *cellulosa* elsewhere, which probably is owing to their being inclosed in the bones, where they are not so much stretched or extended as in other parts.

The MARROW is the oily part of the blood, separated by small arteries, and depositated in these cells. Its colour and consistence may therefore

(*a*) Ruysch. Thesaur. 9. num. 2. et Adversar. dec. III. obs. 9.

therefore vary according to the ſtate of the veſſels, and their diſtribution on the membranes of the cells.

The marrow, as well as the other fat of the body chemically analized, yields, beſides oil and water, a conſiderable proportion of an acid liquor, but no *alcali* (*a*). This may be the reaſon of its being leſs putriſcent than the blood or moſt other parts of animals (*b*), which is a neceſſary quality in a ſubſtance that is conſtantly expoſed to a conſiderable degree of heat, and is more in a ſtagnating condition than the other liquors.

Beſides the arteries, which I mentioned already (p. 9.), to be ſent from the bones to the marrow, there is at leaſt one artery for each bone; ſeveral bones have more, whoſe principal uſe is to convey and ſecern this oily matter. After theſe arteries have pierced the ſolid ſide of a bone, they are divided into ſeveral branches; which ſoon are diſtributed every where on the internal *perioſteum*, and afterwards ſpread their branches inwards on the medullary cells, and outwards through the tables of the bone.

The blood, which remains after the ſecretion of the marrow, is returned by proper veins, which are collected from the membranes into one or two large trunks, to paſs out at the ſame holes or paſſages at which the artery or arteries enter.

(*a*) Grutzmaker Diſſert. de oſſium medulla.—Haller. Element phyſiolog. lib. 4. ſect. 4.

(*b*) Pringle Append. to camp diſeaſes exper. 47.

The general rule of the small veſſels decreaſing in their capacities as animals advance in age, to which many phænomena in the animal œconomy are owing, obtains here: For though the trunks of the medullary veſſels enlarge as animals turn older; yet the ſmall branches become ſmaller; as is evident from injections, which cannot be made to paſs near ſo far in theſe veſſels of adults as of children. Hence the marrow is bloody in children, oily and balmy in middle age, and thin and watery in old people.

By experiments made on the marrow, when bones of living animals are opened or cut thro' (*a*), and, from the racking pain with which ſuppurations within bones are frequently attended, we have ſufficient proof that the membranes here are ſenſible, and conſequently have nerves diſtributed to them. *Hippocrates* (*b*) might therefore ſay juſtly, that a wound penetrating into the cavity of a bone may produce a *delirium*.

The veſſels of the marrow, wrapt up in one common coat from the *perioſteum*, paſs thro' the bones by proper canals; the moſt conſiderable of which are about the middle of each bone, and are very oblique. Sometimes theſe veſſels continue at a little diſtance in their paſſage when the canal is divided by a ſmall bony partition or two.

From the ſtructure of the contents of the bones, we may judge how theſe parts, as well as

(*a*) Du Verney, Memoires de l'Acad. des ſciences, 1700.
(*b*) Aphoriſm, § 7. aph. 24.

as others, may be subject to oidema, phlegmon, erysipelas, schirrhus, &c. and may thence be led to a cure of each, before the common consequence, putrefaction, takes place, and frequently occasions the loss of the limb, if not of the patient.

The marrow is of very considerable use to the bones; for, by entering their transverse canals, and passing from them into the longitudinal ones, it is communicated to all the plates, to soften and connect their fibres, whereby they are preserved from becoming too brittle; as we see they do in burnt bones, or those long exposed to the air; in people labouring under old age, pox, or scurvy: In all which cases, the oil is either in too little quantity, or has its natural good qualities changed for worse ones.

Besides this advantage which the substance of bones has from the marrow, their articulations are said (*a*) to receive no less benefit from it: for it is thought that the marrow passes into the articular cavities, through the holes which are in the bones near the large joints. And, as a proof of this, it is alledged, that butchers, upon seeing the greater or lesser quantity of marrow, in the bones of cows, can tell whether they have travelled far or little before they were slaughtered.

When the marrow, after having served the uses mentioned, is reassumed into the mass of blood, (as it is continually, in common with all other secreted liquors that have not passages formed

(*a*) Joan de Muralto Vade mecum anat. exercit. 5. § 3. Havers Osteolog. nov. disc. 3, p. 179.

formed for conveying them out of the body), it corrects the too great acrimony communicated to the saline particles of our fluids by their circulation and heat; in the same manner as lixivial salts are blunted by oil in making soap. Hence, in acute diseases, the marrow, as well as the other fat of the body, is quickly wasted, but must be immediately supplied by liquors from the vessels; seeing the cells within the bones, which have no assistance to their contraction from the pressure of the atmosphere, cannot collapse, as the *tela cellularis* under the skin does, when the liquor in its cells is absorbed; the bones therefore are always full.

Since it is the nature of all oil to become thin and rancid when exposed long to heat, and bones have much oil in their firm hard substance, we may know why an ungrateful smell, and dark coloured thin *ichor*, proceed more from corrupted bones than from other parts of the body; and we can understand the reason of the changes of colour which bones undergo, according to their different degrees of mortification ——Hence likewise we may learn the cause of a *spina ventosa*, and of the difficulty of curing all *caries* of bones proceeding from an obstruction, and consequent putrefaction of the marrow; and of the quick pulse, thirst, and *hectic paroxysms*, so often attending these diseases. These *phænomena* also teach us the reason of the fatal *prognosis* taken from black fetid urine in fevers.

Though bones so far agree in their structure and annexed parts, yet we may observe a considerable

ſiderable difference among them in their magnitude, figure, ſituation, ſubſtance, connection, uſes, *&c.* From which authors have taken occaſion to diſtinguiſh them into as many claſſes as they could enumerate of theſe different circumſtances. But theſe being obvious to every perſon that looks on bones, I ſhall only mention one of them; which comprehends very near the whole bones of the body and at the ſame time leads us to examine the moſt conſiderable variety that is to be found in the diſpoſition of their conſtituent parts, and in their uſes. It is this, that ſome bones are *broad* and *flat*, while others are *long* and *round*.

The *broad* bones have thin ſides, by the plates being ſoon and equally ſent off to form the lattice-work; which therefore is thicker, and nearly of an equal form all through. By this ſtructure, they are well adapted to their uſes, of affording a large enough ſurface for the muſcles to riſe from, and move upon, and of defending ſufficiently the parts which they incloſe.

The *round* bones have thick ſtrong walls in the middle, and become very thin towards their ends, which is owing to very few plates ſeparating at their middle; where, on that account, the *cancelli* are ſo fine and ſmall, that they are not taken notice of: But ſuch bones are ſaid to have a large reſervoir of oil in this place. Towards their ends the lattice-work becomes very thick, and rather more complete than in the other ſort of bones.—Theſe round bones having ſtrong forces naturally applied to them, and

and being otherwiſe expoſed to violent injuries, have need of a cylindrical figure to reſiſt external preſſure, and of a conſiderable quantity of oil to preſerve them from becoming too brittle. Beſides which, they are advantageouſly provided with thick ſides towards their middle, where the greateſt forces are applied to injure them; while their hollowneſs increaſes their diameter, and conſequently their ſtrength to reſiſt forces applied to break them tranſverſely (*a*). Thus, for inſtance, in eſtimating the proportional reſiſtence of two cylindrical bones of unequal diameters, but conſiſting of an equal number of ſimilar fibres uniformly diſpoſed round each, it is plain,

1. That the abſolute force of theſe two bones is equal, becauſe they conſiſt of equal numbers of ſimilar fibres.

2. That the abſolute forces of all the fibres in each bone have the ſame effect in reſiſting any power applied to break them, as if the ſum of all their forces was united in the reſpective centers of the tranſverſe ſections where the fractures are to be made. For, by hypotheſis, the fibres being uniformly diſpoſed in each, there is not any fibre in either bone that has not a correſponding fibre; the ſum of both whoſe diſtances from the axis of revolution (about which all the parts of the bone muſt revolve in breaking) is equal to two ſemi-diameters of the bone: Conſequently each fibre, and all the fibres, may be regarded as reſiſting at the diſtance of one ſemi-diameter or *radius* from this axis, that is, in the center.

3. Since

(*a*) Galilei Mechanic. dialog. 2.

3. Since the united force of all the fibres is to be regarded as reſiſting at a diſtance from the center of motion equal to the ſemi-diameter, it follows, that the total reſiſtance of all theſe fibres, or the ſtrength of the bone, is proportional to its ſemi-diameter, and conſequently to its diameter.

I have here taken for an example one of the moſt ſimple caſes for calculating the proportional forces of bones. But, was it not too foreign to the preſent deſign, it might be univerſally demonſtrated, that, of whatever figure bones are, and in whatever manner their fibres are diſpoſed, their ſtrength muſt always be in a *ratio*, compounded of the area of their tranſverſe ſections, or of their quantity of bony matter, and of the diſtance of the center of gravity of theſe ſections from the center of motion or fulcrum, on which the bone is ſuppoſed to be broken (*a*).

Since therefore the ſtrength of bones depends on their number of fibres, or quantity of matter, and the largeneſs of their diameters, one may conclude, that the part of a bone formerly fractured, and re-united by a *callus*, muſt be ſtronger than it was before the fracture happened; becauſe both theſe advantages are obtained by a *callus*; which is a wiſe proviſion, ſince bones are never ſet in ſuch a good direction as they were naturally of; and then wherever a *callus* is formed, there is ſuch an obſtruction of the veſſels, that if the bone was again

(*a*) See the demonſtration of this theorem by Dr Porterfield in the Edinburgh Medical eſſays, vol. i. art. 10.

again broken in the ſame place, the *oſſific* matter could not ſo eaſily be conveyed to reunite it. This *callus* may indeed, for want of compreſſion, be allowed to form into a ſpongy cellular ſubſtance (*a*); but even in this caſe the ſtrength of the bone is here increaſed by one or both the cauſes above-mentioned.

Many bones have protuberances, or *proceſſes**, riſing out from them. If a *proceſs* ſtands out in a roundiſh ball, it is called *caput*, or *head*.—If the head is flatted, it obtains the appellation of *condyle*.———A rough unequal protuberance, is called *tuberoſity*. ——When a *proceſs* riſes narrow, and then becomes large, the narrow or ſmall part is named *cervix*, or *neck*.———Long ridges of bones, are called *ſpines*.———Such proceſſes as terminate in a ſharp point, have the general name of *coronæ*†, or *coroncid*, beſtowed on them, though moſt of them receive particular names from the reſemblance they have, or are imagined to have, to other ſubſtances, *e. g. maſtoid, ſtyloid, anchoroid, coracoid, ſpinal, &c.*——Such proceſſes as form brims of cavities, are called *ſupercilia*‡.

Proceſſes ſerve for the advantageous origin and inſertion of muſcles, and render the articulations firm and ſtable.

Before

(*a*) Ruyſch. Theſaur. 8. n. 49. Muſ. anat. thec. B. repoſit. 2. n. 2.

* Ἀπόφυσεις, ἔκφυσεις, ἔξοχὴ, πρόβολὴ, πρόβλημα, Exceſſus, explanatio, tuberculum, gibbus, eminentia, productio, extuberantia, projectura, enaſcentia.

† Roſtra, glandes.

‡ Ὀφρυες, ἄμβονες, χείλη, Labra.

Before leaving this subject, we must remark, that much the greater number of what are called processes in adult bones, discover themselves in children to be *epiphyses*, or distinct bones, which are afterwards united to the other parts; such are the *styloid* processes of the temporal bones, processes of the *vertebræ*, *trochanters* of the thigh, *&c.* However, as I design to insist chiefly on the description of the adult skeleton, in which the union of these parts is so intimate, that scarce any vestige remains of their former separation, I shall retain the common appellation of *apophyse*, or process, to all such protuberances; but shall remark the principal ones, that have no just title to this name, when they occur in the description of particular bones.

On the surfaces of a great many of the bones there are cavities, or depressions: If these are deep, with large brims, authors name them *cotylæ*†.——If they are superficial, they obtain the designation of *glenæ*, or *glenoid*. These general *classes* are again divided into several *species*:—Of which *pits* are small roundish channels sunk perpendicularly into the bone.—*Furrows* are long narrow canals, formed in the surface;——*nitches* or *notches*, small breaches in the bone;—*sinuosities*, broad, but superficial depressions without brims;——*fossæ*, large deep cavities, which are not equally surrounded by high brims;—*sinuses*, large cavities within the substance of the bones, with small apertures;——*foramina*, or holes, canals that pierce quite through the substance of the bones.——When

† Κοτυλίδες, ὀξυβάφοι, Acetabula, pixides buccellæ,

this laſt ſort of cavity is extended any long way within a bone, the middle part retains the name of *canal*, and its ends are called *holes*.

The cavities allow the heads of bones to play in them; they lodge and defend other parts; they afford ſafe paſſage to veſſels, muſcles, *&c.* To mention more would engage us too much in the hiſtory of particular bones, which more properly belongs to the demonſtration of the *ſkeleton*, where we ſhall have occaſion to obſerve theſe ſeveral ſpecies of cavities.

To far the greater number of bones, whoſe ends are not joined to other bones by an immoveable articulation, there are ſmaller ones annexed, which afterwards becomes ſcarce diſtinguiſhable from the ſubſtance of the bone itſelf. Theſe are called *epiphyſes*, or *appendices**. Some bones have one, others have two, three, or four of theſe *appendices* annexed by the meanes of cartilages, which are of a conſiderable thickneſs in children, but by age become thinner; the offification proceeding from the end of the bone on one ſide, and from the *epiphyſes* on the other, till at laſt, in adults, the place of their conjunction can ſcarcely be ſeen on the external ſurface; and it is only ſometimes that we can then ſee any mark of diſtinction in the *cancelli* (*a*).

Several proceſſes (*e. g. trochanters* of the thigh, *ſpine* of the *ſcapula*, *&c.*) have *epiphyſes*; and proceſſes frequently riſe out from *epiphyſes*;

* Applantatio, additamentum, adnaſcentia, adnexum, perone.

(*a*) Winſlow, Expoſition anatomique de corps humain, traite des os ſecs, § 116.

epiphyſes; for example, at the lower end of the *femur*, *ulna*, *tibia*, &c. (*a*).

The *epiphyſes* are united chiefly to ſuch bones as are deſtined for frequent and violent motion; and for this purpoſe they are wiſely framed of a larger diameter than the bone they belong to; for by this means, the ſurface of contact between the two bones of any articulation being increaſed, their conjunction becomes firmer, and the muſcles inſerted into them act with greater force, by reaſon of their axes being further removed from the center of motion. Theſe advantages might indeed have been obtained by the expanſion of the end of the bone itſelf, to a thickneſs equal to that of the *epiphyſes;* but then the conſtant ſeparation of new plates to form ſo wide a cellular ſtructure, muſt have left the ſolid ſides of the bones ſo thin, as to yield eaſily, either to the action of the muſcles fixed to them, and paſſing over them, to the weight ſeveral of them are obliged to ſupport, or to the application of any other external force.

Several anatomiſts (*b*) thought that the *epiphyſes* ſerve other purpoſes: ſuch as, ſecuring the ligaments of the articulations which riſe out from between the bones and them; for, as ſoon as theſe parts are intimately joined, the ligaments inſinuated betwixt them muſt have a much ſtronger connection than they could have to the ſmooth ſurface of the bones. Such an interception of the ligament between the body

(*a*) Veſal. De human. corp. fabrica, lib. 1. cap 3.
(*b*) Collumb. De re anatomica, lib. 1. cap. 2.—Fallop. Expoſ. de oſſibus, cap. 11.

of the bone and its *epiphyſe* is not to be ſeen; but as, at this place, the bone remains longer ſoft than any where elſe, and the adheſion of the *perioſteum*, and of ligaments to bones, is always ſtronger in proportion to the bones being neareſt to the conſiſtence of thoſe parts, which is, being ſofteſt, the opinion of theſe writers concerning the ſtronger connection of the ligaments, where the bones and *epiphyſes* join, is not without ſome foundation.

Poſſibly too, by the fibres of *epiphyſes* not extending themſelves ſo longitudinally as thoſe of the bones, there may be leſs chance of the former running into each other, than of the latter.

The ſoftneſs of the ends of bones may be of ſome advantage in the womb, and at birth, after which the oſſification begins at different points to form *epiphyſes*, before the oſſification can extend from the middle to the ends of the bones (*a*).

However ſolid and compact adult bones are, yet they were once cartilages, membranes, nay, a mere gelly. This needs no further proof, than repeated obſervations of *embryos* when diſſected: And how much more tender muſt the bones be before that time, when neither knife nor eye is capable to diſcover the leaſt rudiments of them? By degrees they become more ſolid, then aſſume the nature of griſtles, and at laſt oſſify; the coheſion of their plates and fibres always increaſing in proportion to their increaſed ſolidities; as is evident from the time neceſſary to unravel the texture of

(*a*) Haller de ſtudio medic. p. 267.

of bones of people of different ages, or of denſe and of ſpongy bones, or of the different parts of the ſame bone, and from the more tedious exfoliations of the bones of adults than of children.

After any part of a bone is fully oſſified, its fibres are extended little more in length at that part, tho' they increaſe there in thickneſs, and tho' their ſofter parts continue to become longer (*a*).

As the ſolidity of bones increaſes, their *perioſteum* more eaſily ſeparates from them. When bones are membranous, the *perioſteum* and they cannot be diſtinguiſhed; they appear to be the ſame ſubſtance. When they are cartilages, their membrane adhere ſo firmly to them, that it is difficult to ſeparate it from them. Where the rigid bony fibres are, the *perioſteum* is eaſily taken off. Is the ſimilarity of ſtructure and conſequent greater attraction of the membrane and ſubſtance it incloſes, while they are both flexible, the cauſe of their greater adheſion? or is it owing to the veſſels that go from the one to the other being then larger? or do both theſe cauſes combine to produce this effect? Or is the membrane or cartilage, which becomes bone afterwards, to be conſidered as the ſame ſubſtance with the *perioſteum* (*b*)? and muſt all theſe plates of bones be therefore ſaid to be layers of the *perioſteum* hardened (*c*).

(*a*) Hales's Vegetable ſtatics, p. 293.—Du Hamel Memoires de l'acad des ſciences, 1742.
(*b*) Memoires de l'acad des ſciences, 1744.
(*c*) Memoires de l' acad des ſciences, 1743.

The offification of bones depends principally on their veffels being fo difpofed, and of fuch diameters, as to feparate a liquor, which may eafily turn into a bony fubftance, when it is deprived of its thinner parts; as feems plain from the obfervation of the callous matter feparated after fractures and ulcers, where part of the bone is taken out: For in thefe cafes, the veffels extending themfelves, and the liquors added to them, are gradually formed into granulated flefh; which fills up all the fpace where the bone is taken from, then hardens, till it becomes as firm as any other part of the bone. This happens frequently, even when the ends of the diffeafed bone are at a confiderable diftance from each other (*a*).

The induration of bones is alfo greatly affifted by their being expofed, more than any other parts, to the ftrong preffure of the great weights they fupport, to the violent contraction of the mufcles fixed to them, and to the force of the parts they contain, which endeavour to make way for their own further growth. By all this preffing force, the folid fibres and veffels of bones are thruft clofer; and fuch particles of the fluids conveyed in thefe veffels as are fit to be united to the fibres, are fooner and more firmly incorporated with them, while the remaining fluids are forcibly driven out by the veins, to be mixed with the mafs of blood. In confequence of this, the veffels gradually

(*a*) Hildan. de vuln. graviff.—Med. eflays, vol. 1. art. 23.—Job a Meckren obf. 69.—Mem. de l'acad. des fciences, 1742.——See a collection of fuch cafes in Bochmer de offium callo.

dually diminish as the bones harden. From which again we can understand one reason, why the bones of young animals sooner reunite after a fracture than those of old, and why cattle that are put too soon to hard labour seldom are of such large size as others of the same brood who are longer kept from labour.

That the ossifying of bones greatly depends on pressure, seems to be evinced from the frequent examples we meet with of other parts turning bony, when long exposed to the pressing force of the surrounding parts, or when they are subjected to the like circumstances by their own frequent and violent contraction. Witness, the bones found frequently near the base of the heart in some old men (*a*), and in several other creatures. Nay, the muscular substance of the heart has been ossified in such (*b*), and the arteries of old men often become bony.—— The cartilages of the *larynx* are generally ossified in adults.—In beasts of burden, the cartilages between the *vertebræ* of the back very often change into complete bones; and, being intimately united with the *vertebræ*, the whole appears one continued bone:—Nor is the *periosteum* exempted from such an induration (*c*).

To confirm this argument still farther, we may observe, that bones begin their ossification

(*a*) Riolan. Comment. de ossib. cap. 32.——Bartholin Hist. medic. cent. 1. hist. 50.——Ibid. cent. 2. hist. 45.

(*b*) Chesselden, Anatomy, book 1. introd.—Garengeot, Hist. de l'acad. des sciences, 1726.

(*c*) Peyer. Ephemerid. German. decur. 2. ann. 7. observ. 205.

cation at the places where they are moſt expoſed to theſe cauſes, *viz.* in the cylindrical bones from a middle ring, and in the broad ones, at or near their center, from one or more diſtinct points. The reaſon of which is, That theſe parts are contiguous to the bellies of the muſcles annexed to the bones, where the ſwelling of theſe moving powers is greateſt. What the effects of this may be, let any judge, who view ſome of the bones, as the *ſcapula*, and *oſſa ilium*, which are covered with muſcles on each ſide; how compact and thin they are in adults, where the bellies of the muſcles were lodged; whereas in children they are thicker. But this being the middle part of theſe bones, where the greateſt number of fibres is, this particular place would have been much thicker in adults, had not this forcible cauſe been applied, which has not had ſuch effects in children, whoſe muſcles have not been much exerciſed.—Beſides, if we allow that all the parts of a bone are equally increaſed by the conſtant ſupply of new particles, each fibre, and every particle of a fibre, endeavours to make way for its own growth, by puſhing the one next to it; and conſequently by far the greateſt preſſure is on the middle to make the particles firm, and therefore to begin their oſſification there. Laſtly, the pulſation of the medullary arteries, which enter the bones near to this middle part, may, as authors have alledged, contribute perhaps ſomewhat to this induration.

From the effects of preſſure only it is, that we can account for the bones of old people having their ſides much thinner, yet more

denſe

denſe and ſolid, while the cavities are much larger than in thoſe of young people; and for the prints of muſcles, veſſels, &c. being ſo much more ſtrongly marked on the ſurfaces of the former than of the latter, if they belong to people of near the ſame condition in life.—— Preſſure muſt likewiſe be the cauſe, which, in people of equal ages, makes theſe prints ſtronger in the bones of thoſe who had much labour and exerciſe, than they are in people who have led an indolent unactive life.

Perhaps both the cauſes of oſſification above-mentioned, may be aſſiſted by the nature of the climate people live in, and the food they uſe. Whence, in hot countries, the inhabitants ſooner come to their height of ſtature than in the northerly cold regions: And thence ſeems to have ariſen the common practice among the ladies, of making puppies drink brandy or ſpirit of wine, and of bathing them in theſe liquors, to prevent their growing big. Nay, it has been obſerved, that much uſe of ſuch ſpirits has occaſioned parts, naturally ſoft, to petrify in ſome, and to oſſify in other people of no great age (*a*).

From the foregoing account of the ſtructure of bones, and of their oſſification, we may underſtand the reaſons of the following phænomena.

How the natural colour of bones may be changed by ſome ſorts of food (*b*).

Why

(*a*) Littre, Hiſtoire de l'acad. des ſciences, 1706.—— Geoffroy, Memoires de l'acad. des ſciences, 1706.

(*b*) Philoſoph. Tranſact. 442. art. 8. num. 443. art. 2. num. 457. art. 4. Mem. de l'acad. des ſciences, 1739. 1742.

Why the bones of ſome people are ſo long in hardening, and in others never completely indurate.

Why, in ſuch whoſe oſſification is ſlow, the bones are generally thicker in proportion to their lengths, eſpecially at their ends; as in the *rickets*.

How hard firm bones have become ſoft and pliable by diſeaſes (*a*).

Why in ſome diſeaſes, *epiphyſes* ſeparate from bones (*b*), and the ends of fractured bones come aſunder many years after their fractures appeared to be cured (*c*).

How bones may waſte and diminiſh (*d*).

How bones may become ſolid all through, without any appearance of *cancelli* (*e*).

How *nodes*, *tophi*, and *exoſtoſes*, happen after the eroſion of the external plates of bones in the *lues venerea*, *ſcurvy*, *rheumatiſm*, and *gout*.

How bones exfoliate by the riſing of granulated fleſh from their ſurface.

How and from what *callus* is formed after a fracture *(f)*.

(*a*) Hiſtoire de l'acad. des ſciences, 1700.---Mem. 1722.---Gagliardi. Anatom. oſſium. cap. 2. obſerv. 3.---Ephem. Germ. decur. 1. ann. 1. obſ. 37. et ſchol. decur. 2. ann. 7. obſ. 212. 235. decur. 3. ann. 2. obſ. 3.---Philoſ. Tranſ. No. 470. § 3. Ibid. vol. 48. § 4. and 44.

(*b*) Memoires de l'acad. des ſciences, 1699.---Diemerbroek, Anat. lib. 9. cap. 19.---Cowper's Anat. explic. tab. 96. fig. 1.

(*c*) Anſon's Voyage.

(*d*) Cheſelden. Anat. book 1. introd.---Hiſt. de l'acad. des ſciences, 1700.

(*e*) Ruyſch. Theſaur. 2. arc. 5. theſ. 3. loc. 1. numb. 5. theſ. 9. numb. 2. not. 3.---Bochmer de callo oſſium.

(*f*) Memoires de l'acad. des ſciences, 1741.---Debtleef de oſſium callo.

Why *callus* appears to be rather the continued ſubſtance of the *perioſteum* than of the bone, while it remains ſoft and flexible; but ſeems continued with the bone after it oſſifies (*a*).

Why *callus* is ſenſible, while it is ſoft, but becomes inſenſible when it hardens.

What occaſions ſometimes ſuch difficulty in curing fractured bones; or why they never reunite, though they are reduced, and all proper means towards a cure are uſed (*b*).—Are the bones of women with child more tedious in reuniting than thoſe of other people (*c*)?

Why *calluſes*, after fractures, are ſometimes very thick and protuberant.

What difference there ought to be in the application of bandages to fractures of the bones of old and of young patients.

How bones, remaining long unreduced after a luxation, may have their form ſo changed as to make their reduction very difficult, if not impoſſible (*d*).

Whoever is deſirous to know, in what time and order each bone and its ſeveral parts begin to aſſume a bony nature, let him conſult *Kerkringius*

(*a*) Mem. de l'acad. 1741.

(*b*) Meckren Obſerv. medico-chirurg. obſ. 71.---Ruyſch. Adverſ. dec. 2. § 2. obſerv. anat. chir. obſ. 4.---Van Swieten in Boerhaave Aphor. § 354.

(*c*) Hildan. centur. 5. obſ. 87. et cent. 6. obſ. 68.——Philoſ. Tranſact. No. 494. § 21.

(*d*) Saltzman. Obſ. decur. obſ. 6.---Memoires de l'acad. de chirurgic. tom. 2. p. 153.---Bochmer Inſtit. oſteolog. § 596.

Kerckingius (*a*), who gives us the delineations of abortions from three days after conception, and traces the oſſification of the bones from three weeks, and a month, till the time of the birth: To whom ſhould be added *Coiterus* (*b*) and *Eyſſonius* (*c*). An account of this ſubject might alſo be collected out of Ruyſch's works, where ſome of the miſtakes committed by the former authors are corrected: and ſeveral more particulars, to make the hiſtory of the *oſteogenea* more accurate, have ſince been added by *Neſbit* (*d*) and *Albinus* (*e*).

I muſt refer to the authors now quoted for the more curious part of the human oſteogeny; not having preparations enough to give ſuch a full hiſtory of it as is done by them. But I ſhall endeavour to explain the more uſeful and neceſſary part of the oſteogeny, by ſubjoining to the deſcription of each bone of an adult, its condition in ripe children; that is, in ſuch as are born at the ordinary time; and ſhall point out what parts of each are afterwards joined in form of *epiphyſes*. This, with the following general rules, ſeem to me ſufficient for underſtanding what of this ſubject is neceſſary in the practice of phyſic and ſurgery.

1. Wherever I mention any parts being cartilaginous, or their being ſtill ſeparable from the other parts of the bone to which they belong,

(*a*) Anthropograph. ichnograph. et oſteogenea foetuum.
(*b*) De oſſibus foetus abortivi.
(*c*) De oſſibus infant. cognoſcend. et curand.
(*d*) Human Oſteogeny explained.
(*e*) Icones oſſium foetus humani; accedit oſteogeneæ brevis hiſtoria.

long, I would be underſtood to hint, that, about ſeven or eight years of age, ſuch parts are oſſified and united to their proper bones, unleſs when it is ſaid, that they are afterwards formed into *epiphyſes*.

2. Such as become *epiphyſes*, are generally oſſified at ſeven or eight years of age; but, being for the moſt part moiſtened by *ſynovia*, their external ſurface is ſtill ſomewhat cartilaginous, and they are not yet united to their bones.

3. At eighteen or twenty years of age the *epiphyſes* are entirely oſſified, and have blended their fibres ſo with the body of the bone, as to make them inſeparable without violence.

The knowledge of this part of the *oſteogeny* I think neceſſary, to prevent dangerous miſtakes in the cure of ſeveral diſeaſes. As for example: Without this knowledge, the ſeparation of an *epiphyſe* might be miſtaken for a fracture or luxation.——The interſtice of two parts of a bone not yet joined, might be judged to be a fiſſure.——A *diaſtaſis*, or ſeparation of ſuch disjoined pieces of a bone, might be thought a fracture.—The protruſion of one piece, or its overlopping any other, could be miſtaken for an excreſcence or *exoſtoſis*.——Such errors about the nature of a diſeaſe would give one very different indications of cure, from what he would have, if he really underſtood his patient's caſe. And very often the knowledge of the different inequalities on the ſurfaces of bones, muſt direct us in the execution of what is proper to be done to cure ſeveral of their diſeaſes.

Having thus conſidered the bones when ſingle, we ought next to ſhew the different manner of their conjunctions†. To expreſs theſe, anatomiſts have contrived a great number of technical terms; about the meaning, propriety, and claſſing of which, there has unluckily been variety of opinions. Some of theſe terms it is neceſſary to retain, ſince they ſerve to expreſs the various circumſtances of the articulations, and to underſtand the writers on this ſubject.

The ARTICULATIONS are moſt commonly divided into three claſſes, *viz. ſymphyſis*, *ſynarthroſis*, and *diarthroſis*.

Symphyſis, which properly ſignifies the concretion or growing together of parts, when uſed to expreſs the articulations of bones, does not ſeem to comprehend, under the meaning generally given to it, any thing relating to the form or motion of the conjoined bones; but by it moſt authors only denote the bones to be connected by ſome other ſubſtance; and as there are different ſubſtances which ſerve this purpoſe, therefore they divide it into the three following ſpecies:

1. *Synchondroſis* ‡, when a cartilage is the connecting ſubſtance: Thus the ribs are joined to the *ſternum*; thus the bodies of the *vertebræ* are connected to each other; as are likewiſe the *oſſa pubis*.

2. *Syn-*

† Σύνταξις, σύνδεσις, συμβολὴ, ὁμιλια, compoſitio, connexio, articulatio, conjunctio, nodus, commiſſura, ſtructura, compages.

‡ Amphiarthroſis.

2. *Synneurosis*, or *syndesmosis*, when ligaments are the connecting bodies, as they are in all the moveable articulations.

3. *Syssarcosis*, when muscles are stretched from one bone to another, as they must be where there are moveable joints.

The *second* class of articulations, the *synarthrosis*, which is said to be the general term by which the immoveable conjunction of bones is expressed, is divided into three kinds.

1. The *future* † is that articulation where two bones are mutually indented into each other, or as if they were sowed together, and is formed by the fibres of two bones meeting while they are yet flexible and yielding, and have not come to their full extent of growth; so that they mutually force into the interstices of each other, till, meeting with such resistance as they are not able to overcome, they are stopped from sprouting out farther, or are reflected; and therefore these indentations are very different both in figure and magnitude: Thus the bones of the head are joined; thus *epiphyses* are joined to the bones, before their full connection and union with them.

Under this title of *future*, the *harmonia* of the antients may be comprehended; scarce any unmoved bones being joined by plain surfaces (*a*).

2. *Gomphosis* ‡ is the fixing one bone into another, as a nail is fixed in a board: Thus the teeth are secured in their sockets,

† Ῥαφη.

(*a*) Vessal. Observ. Fallop. Examen.

‡ Conclavatio.

3. *Shindyleſis* or *ploughing* (*a*), when a thin *lamella* of one bone is received into a long narrow furrow of another: Thus the *proceſſus azygos* of the *ſphenoid*, and the naſal proceſs of the *ethmoid* bone, are received by the *vomer*.

The *third* claſs, or *diarthroſis**, is the articulation where the bones are ſo looſely connected as to allow large motion. This is ſubdivided into three kinds.

The firſt is *enarthroſis*, or the ball and ſocket, when a large head is received into a deep cavity; as the head of the *os femoris* is into the *acetabulum coxendicis*.

The ſecond is *arthrodia*, when a round head is received into a ſuperficial cavity; as in the articulation of the arm-bone and *ſcapula*. Theſe two ſpecies of *diarthroſis* allow motion to all ſides.

The third is *ginglimus* †, which properly ſignifies the hinge of a door or window; in it the parts of the bones mutually receive and are received, and allow of motion two ways: Workmen call it *charnal*.

The *ginglimus* is generally divided into three kinds, to which ſome (*b*) give the names of *contiguous* ‡, *diſtant* ‖, and *compound* §.

The firſt kind of *ginglimus* is, when a bone has ſeveral protuberances and cavities, which anſwer to as many cavities and proceſſes of the other.

(*a*) Keil, Anat. chap. 5. § 3.

* Απαρθρώσις, dearticulatio, abarticulatio.

† Articulatio mutua.

(*b*) Baker, Curſ. oſteolog. demonſtr. 1.

‡ Proximus.

‖ Longus.

§ Compoſitus.

other bone, with which it is articulated; as in the conjunction of the *femur* with the *tibia*.

The second species is, when a bone receives another at one end, and is received by the same bone at the other end; as in the *radius* and *ulna*.

The last sort is, when a bone receives another, and is received by a third; as in the oblique processes of the *vertebræ*.

When I first mentioned the articulations of bones, I said there were different opinions concerning the use of their technical names, *e. g.* It has been said, that *symphysis* should be the name for the immoveable articulations, and *synarthrosis* should be understood to be the conjunction of bones by some connecting *medium*.——Those who have taken *symphysis* in the sense I did, of its expressing the conjunction of bones with a connecting substance, have disagreed in their definition of it; some inserting, and others leaving out, its allowing motion.—Where they have agreed in their definition, they have not been of the same mind concerning the species of it. For several think the *Sysarcosis* and *syndesmosis* applicable to so many joints which are universally allowed to be classed under the *diarthrosis*, that it must create confusion to name them by any species of the *symphysis*.——Few keep to such a general definition of the *synchondrosis* as I have done; and, whether they determine it to allow no motion, or an obscure or a manifest one, bring themselves into difficulties, because there are examples of all these three kinds.——Some again, by too nicely distinguishing obscure and

manifeſt motions of bones, have blended the *ſynarthroſis* and *diarthroſis*, and from thence have branched out the different compound ſpecies of articulations that may be formed of them ſo far, that they could find no examples in the body to illuſtrate them by—It would be tedious to enumerate more of the jarring opinions, and it would be far more ſo to give a detail of the arguments uſed by the diſputants. It is ſufficient for my purpoſe, that it is underſtood in what ſenſe I take theſe technical terms; which I do in the following manner:

When I mention the *ſymphyſis* or *ſynarthroſis*, or any ſpecies of them, I ſhall always underſtand them according to the explication already given of them. But though the preceeding account of the *diarthroſis*, or articulation of moveable bones has been almoſt univerſally received; yet, ſeeing it does not comprehend all the moveable articulations of the body, and one of its ſpecies does not anſwer to any notion we can have of the conjunction of two bones, I muſt beg leave to change the definitions and kinds of theſe joints.

I would call *diarthroſis* that conjunction of bones, whereby they are fitted for motion, being each covered with a ſmooth cartilage, connected by one or more common ligaments, and lubricated with liquor at the conjoined parts. In which definition, I have no regard to the quantity of motion which they really do perform; the motion being often confined or enlarged by ſome other cauſe not immediately depending on the frame of the two ſurfaces of the

the bones forming the particular joint which then is considered.

The first species of the *diarthrosis*, *viz.* the *enarthrosis* or ball and socket, I would define more generally than above, That articulation where a round head of one bone is received into a cavity of another, and consequently, without some foreign impediment, is capable of motion to all sides. Examples of this kind are to be seen in the articulation of the thigh-bone and *ossa innominata*; Arm-bone and *scapula*; *astragalus* and *os naviculare*; *magnum* of the wrist, with the *scaphoides* and *lunare*; first bone of the thumb with the second, *&c.*

The second sort, or the *arthrodia*, differing from the *enarthrosis*, in the preceeding account, only in the cavity's being more superficial, which makes no essential difference, especially that in the recent subject, cartilages or ligaments supply the deficiency of bone, ought, in my opinion, to be called with *Vesalius* (*a*), that articulation of two bones adapted for motion, where it is not at first sight obvious which of the two has the head or cavity, or where they are joined by plain surfaces, or nearly so; such is the conjunction of the *clavicle* with the *scapula*; *ossa cuneiformia* with the *os naviculare*; *metatarsal* bones with the *ossa cuneiformia*, *&c.* From the nature of this sort of joint, it is plain, that very great motion cannot be allowed, without the bones going further out of their natural situation, than is convenient or safe.

Ginglimus,

(*a*) De corp. human. fabrica, lib. 1. cap. 4.

Ginglimus, I would reckon that articulation by the form of which the motion of the joined bones moſt be chiefly confined to two directions, which hinges of doors are.

The firſt ſpecies of this is the *trochoides*, when one bone turns on another, as a wheel does on its axis: Thus the firſt *vertebra* of the neck moves on the tooth-like proceſs of the ſecond. This is the moſt proper kind of *ginglimus*.

The ſecond ſpecies ſhould be eſteemed that articulation where ſeveral prominent and hollow ſurfaces of two bones move on each other, within the ſame common ligament; as in the knee, elbow, *&c.*

The third ſort of *ginglimus* is, when two bones are articulated to each other at different parts, with a diſtinct *apparatus* of the motory machines at each; ſuch is the articulation of the *os occipitis* with the firſt *vertebra* of the neck; of any two contiguous *vertebræ*, by their oblique proceſſes; of the ribs with the bodies and tranſverſe proceſſes of the *vertebræ*; of the *radius* with the *ulna*, *tibia* with the *fibula*, *aſtragalus* with the *calcaneum*, *&c.*

I would entirely throw out what is commonly called the third kind of *ginglimus*: For, in examining the conjunction of a bone with two others, as in the common example of a *vertebra* joined with the one above and below, the connection of the middle one with each of the other two ought to be conſidered ſeparately; otherwiſe we might with the ſame propriety eſteem the articulations that the long bones, the *femur*, *tibia*, *humerus*, *&c.* have at their different

ferent ends, as one articulation; which is absurd.

If the moveable bones are not connected and kept firm by some strong substance, they would be luxated at every motion of the joints: and if their hard rough unequal surfaces were to play on each other, their motion would not only be difficult, but the loss of substance from attrition would be great. Therefore *ligaments* are made to obviate the first, and *cartilages* to prevent the other inconveniency. But because ligaments and cartilages turn rigid, inflexible, and rough, unless they are kept moist, a sufficient quantity of proper liquors is supplied for their lubrication, and to preserve them in a flexible state. Seeing then these parts are so necessary to the articulations, I shall next consider their structure, situation, and uses, so far as they are subservient to the bones, and their motions.

LIGAMENTS * are white flexible bodies, thicker and firmer than membranes, and not so hard or firm as cartilages, without any remarkable cavity in their substance, difficultly stretched, and with little elasticity; serving to connect one part to another, or to prevent the parts to which they are fixed from being removed out of that situation which is useful and safe.

After maceration in water, the ligaments can easily be divided; and each ligamentous layer appears composed of fibres, the largest of which are disposed in a longitudinal direction.

The

* Συνδεσμοι, νευρος, copulæ, vincula.

The *arteries* of ligaments are very conſpicuous after a tolerable injection, and the larger trunks of their veins are ſometimes to be ſeen full of blood.

Such ligaments as form the ſides of cavities, have numerous orifices of their arteries opening upon their internal ſurface, which keep it always moiſt: If we rub off that moiſture, and then preſs the ligament, we can ſee the liquor ouſing out from ſmall pores; and we can force thin liquors injected by the arteries into the cavities formed by ligaments.

Theſe exhalent arteries muſt have correſponding abſorbent *veins*, otherwiſe the cavities would ſoon be too full of liquor.

Ligaments then muſt be ſubject to the diſeaſes common to other parts, where there is a circulation of fluids, allowance always being made for the ſize of veſſels, nature of the fluids, and firmneſs of the texture of each part.

Authors generally ſay, that ligaments are inſenſible: and conſequently it may be inferred, that they have no nerves beſtowed on them, But the violent racking pain felt on the leaſt motion of a joint labouring under a *rheumatiſm*, the ſeat of which diſeaſe ſeems often to be in the ligaments, and the inſufferable torture occaſioned by inciſions of ligaments, and by a collection of acrid matter in a joint, or by *tophi* in the gout, would perſuade us, that they are abundantly ſupplied with nerves.

The ligaments which connect the moveable bones commonly riſe from the conjunction of the *epiphyſes* of the one bone, and

are

are inserted into the same place of the other; or where *epiphyses* are not, they come out from the *cervix*, and beyond the *supercilia* of the articulated bones; and after such a manner, in both cases, as to include the articulation in a purse or bag, with this difference, depending on their different motions, that where the motion is only to be in two directions, the ligaments are strongest on those sides towards which the bones are not moved; and when a great variety of motions is designed to be allowed, the ligaments are weaker than in the former sort of articulations, and are nearly of the same strength all round.

Part of the capsular ligaments is composed of the *periosteum*, continued from one bone to another, as was observed *p.* 2. and their internal layer is continued on the parts of the bone or cartilage which the ligament includes (*a*).

Besides these common capsular ligaments of the joints, there are particular ones in several places, either for the firmer connection of the articulated bones, or for restraining and confining the motion to some one side; such are the *cross* and *lateral* ligaments of the knee, the *round* one of the thigh, *&c.*

From this account of the ligaments, we may conclude, that, *cæteris paribus*, in whatever articulation the ligaments are few, long, and weak, the motion is more free and quick; but luxations happen frequently: And, on the contrary, where the ligaments are numerous, short, and strong, the motion is more confined; but such a joint is less exposed to luxations

(*a*)

(*a*) Nesbit, Osteogen.—Philos. transact. No. 470. § 6.

(*a*)——Whence we may judge how neceſſary it is to attend to the different ligaments, and the changes which have been made on them by a luxation, when it is to be reduced.

Ligaments alſo ſupply the place of bones in ſeveral caſes to advantage: Thus the parts in the *pelvis* are more ſafely ſupported below by ligaments than they could have been by bone.——The ligaments placed in the great holes of the *oſſa innominata*, and between the bones of the fore-arm and leg, afford convenient origin to muſcles.—Immoveable bones are firmly connected by them; of which the conjunction of the *os ſacrum* and *innominatum* is an example.——They afford a ſocket for moveable bones to play in, as we ſee part of the *aſtragalus* does on the ligament ſtretched from the heel-bone to the *ſcaphoid*.

Numerous inconveniences may ariſe from too long or ſhort, ſtrong or weak, lax or rigid ligaments.

CARTILAGES * are ſolid, ſmooth, white, elaſtic ſubſtances, between the hardneſs of bones and ligaments, and covered with a membrane, named *perichondrium*, which is of the ſame ſtructure and uſe to them as the *perioſteum* is to the bones.

Cartilages are compoſed of plates, which are formed of fibres, diſpoſed much in the ſame way as thoſe of bones are; as might be reaſonably concluded from obſerving bones in a cartilaginous ſtate before they oſſify, and from ſeeing, on the other hand, ſo many cartilages become bony. This may be ſtill further confirmed

(*a*) Fabric. ab Aquapend. de articul. part. utilit. pare 3.

* Χονδροι.

firmed, by the *exfoliation* which cartilages are subject to, as well as bones.

The *perichondrium* of several cartilages, for example, those of the ribs and *larynx*, has arteries which can be equally well injected with those of the *periosteum*; but the vessels of that membrane in other parts, *e. g.* the articular cartilages, are smaller, and in none of them does injection enter deep into the substance of the cartilages; nay, madder, mixed with the food of animals, does not change the colour of cartilages, as it does that of bones (*a*).

The granulated flesh which rises from the ends of metacarpal or metatarsal bones, when the cartilage exfoliates, after a finger or toe has been taken off at the first joint, is very sensible, from which the existence of nerves in cartilages may be inferred.

While cartilages are in a natural state, it is to be remarked, *first*, That they have no cavity in their middle for marrow. *Secondly*, That their outer surface is softest, which renders them more flexible. *Thirdly*, That they do not appear to change their texture near so much by acids as bones do. And, *lastly*, That as the specific gravity of cartilages is near a third less than that of bones; so the cohesion of their several plates is not so strong as in bones: whence cartilages laid bare in wounds or ulcers, are not only more liable to corrupt, but exfoliate much sooner than bones do.

(*a*) Philos. Transact. No. 442. art. 8. No. 443. art 2. No. 457. art. 4.—Mem. de l'acad. des sciences 1739 et 1742.——Dehtleef de ossium callo.

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Cartilages ſeem to be principally kept from oſſifying, either by being ſubjected to alternate motions of flexion and extenſion, the effects of which are very different from any kind of ſimple preſſure, or by being conſtantly moiſtened (*a*): Thus, the cartilages on the articulated ends of the great bones of the limbs, and the moveable ones placed between the moving bones in ſome articulations, which are obliged to ſuffer many and different flexions, and are plentifully moiſtened, ſcarce ever change into bone; while thoſe of the ribs, and larynx are often oſſified.—The middle angular part of the cartilages of the ribs, which is conſtantly in an alternate ſtate of flexion and extenſion, by being moved in reſpiration, is always the laſt of becoming bony.——In the *larynx*, the *epiglottis*, which is oftener bended and more moiſtened than the other four cartilages, ſeldom is oſſified, while the others as ſeldom eſcape it in adults.

The cartilages ſubſervient to bones, are ſometimes found on the ends of bones which are joined to no other; but are never wanting on the ends, and in the cavities of ſuch bones as are deſigned for motion (*b*). Cartilages alſo are interpoſed between ſuch other cartilages as cover the heads and cavities of articulated bones; nay, they are alſo placed between immoveable bones.

The uſes of cartilages, ſo far as they regard bones, are, to allow, by their ſmoothneſs, ſuch bones as are deſigned for motion, to ſlide eaſily

(*a*) Havers Oſteolog. nov.
(*b*) Celſ. de re medic. lib. 8. cap. 1.

ſily without detrition, while, by their flexibility, they accommodate themſelves to the ſeveral figures neceſſary in different motions, and, by their elaſticity, they recover their natural poſition and ſhape as ſoon as the preſſure is removed.——This ſpringy force may alſo aſſiſt the motion of the joint to be more expeditious, and may render ſhocks in running, jumping, *&c.* leſs.——To theſe cartilages we chiefly owe the ſecurity of the moveable articulations: For without them the bony fibres would ſprout out, and intimately coaleſce with the adjoining bone; whence a true *anchyloſis* muſt neceſſarily follow; which never fails to happen when the cartilages are eroded by acrid matter, or oſſified from want of motion or defect of liquor, as we ſee often happens after wounds of the joints, *paidarthrocace*, *ſcrophula*, and *ſpina ventoſa*, or from old age, and long immobility of joints (*a*).—Hence we may know what the annihilation is which is ſaid to be made of the head of a bone, and of the cavity for lodging it, after an unreduced fracture (*b*). The moveable cartilages interpoſed in joints ſerve to make the motions both freer and more ſafe than they would otherwiſe be.——Thoſe placed on the ends of bones that are not articulated, as on the *ſpine* of the *os illium*, baſe of the *ſcapula*, *&c.*

(*a*) Columb. de re anat. lib. 15.—Deſlandes Hiſt. de l'acad. des ſciences, 1716.—Phil. tranſact. No. 215.—Ibid. No. 461. § 16.

(*b*) Hildan. de ichor. et melicer. acri Celſi, cap. 5.—Ruyſch. Theſ. 8. No. 103.—Saltzman in act Petropolit. Tom. 3. p. 275.

ſerve to prevent the bony fibres from growing out too far.——Cartilages ſometimes ſerve as ligaments, either to faſten together bones that are immoveably joined, ſuch are the cartilages between the *os ſacrum* and *oſſa illium*, the *oſſa pubis*, *&c.* or to connect bones that enjoy manifeſt motion, as thoſe do which are placed between the bodies of the true *vertebræ*, *&c.*—Cartilages very often do the office of bones to greater advantage than theſe laſt could, as in the cartilages of the ribs, thoſe which ſupply brims to cavities, *&c.*

Too great thickneſs or thinneſs, length or ſhortneſs, hardneſs or ſuppleneſs of cartilages, may therefore cauſe great diſorders in the body.

The liquor, which principally ſerves to moiſten the ligaments and cartilages of the articulations, is ſupplied by glands, which are commonly ſituated in the joint, after ſuch a manner as to be gently preſſed, but not deſtroyed by its motion. By this means, when there is the greateſt neceſſity for this liquor, that is, when the moſt frequent motions are performed, the greateſt quantity of it muſt be ſeparated. Theſe glands are ſoft and pappy, but not friable: In ſome of the large joints they are of the conglomerate kind, or a great number of ſmall glandules are wrapt up in one common membrane. Their excretory ducts are long, and hang looſe, like ſo many fringes, within the articulation; which, by its motion and preſſure, prevents obſtructions in the body of the gland or its excretories, and promotes the return of this liquor, when

when fit to be taken up by the abſorbent veſſels, which muſt be in the joints, as well as in the other cavities of the body; and, at the ſame time, the preſſure on the excretory ducts hinders a ſuperfluous unneceſſary ſecretion, while the fimbriated diſpoſition of theſe excretories does not allow any of the ſecreted liquor to be puſhed back again by theſe canals towards the glands (*a*).

Very often theſe fountains of ſlimy liquor appear only as a net work of veſſels.——Frequently they are almoſt concealed by cellular membranes containing the fat—and ſometimes ſmall ſimple mucous *folliculi* may be ſeen (*b*).

The different joints have theſe organs in different numbers and ſizes; the conglomerate ones don't vary much, eſpecially as to ſituation, in the ſimilar joints of different bodies; but the others are more uncertain.

Upon preſſing any of theſe glands with the finger, one can ſqueeze out of their excretories a mucilaginous liquor, which ſomewhat reſembles the white of an egg, or *ſerum* of the blood; but it is manifeſtly ſalt to the taſte. It does not coagulate by acids, or by heat, as the *ſerum* does, but by the latter turns firſt thinner, and, when evaporated, leaves only a thin ſalt film.

The quantity of this *mucilage*, conſtantly ſupplied, muſt be very conſiderable, ſince we ſee what a plentiful troubleſome diſcharge of glary matter follows a wound or ulcer of any

(*a*) Cowper, Anatom. explicat. tab. 79. lit. E, E.
(*b*) Morgagn. Adverſar. 2. animad. 23.

joint; of which liquor the mucilage is a conſiderable part.

The veſſels which ſupply liquors for making the ſecretion of this mucilage, and the veins which bring back the blood remaining after the ſecretion, are to be ſeen without any preparation; and, after a tolerable injection of the arteries, the glands are covered with them.

In a ſound ſtate, we are not conſcious of any ſenſibility in thoſe glands; but, in ſome caſes which I have ſeen, when they inflame and ſuppurate, the moſt racking pain is felt in them: a melancholy, though a ſure proof that they have nerves.

Theſe mucilaginous glands are commonly lodged in a cellular ſubſtance; which is alſo to be obſerved in other parts of the bag formed by the ligaments of the articulation; and contains a fatty matter, that muſt neceſſarily be attenuated, and forced through the including membranes into the cavity of the joint, by the preſſure which it ſuffers from the moving bones.

If then the oil is conveyed from this cellular ſubſtance; and if the attenuated marrow paſſes from the *cancelli* of the bones by the large pores near their ends, or in their cavities, and ſweats through the cartilages there into the articulations; which it may, when aſſiſted by the conſtant heat and action of the body, more eaſily do, than when it eſcapes through the compact ſubſtance of the bones in a ſkeleton: If, I ſay, this oil is ſent to a joint,

joint, and is incorporated with the mucilage, and with the fine lymph that is conſtantly ouſing out at the extremities of the ſmall arteries diſtributed to the ligaments, one of the fitteſt *liniments* imaginable muſt be produced; for the *mucus* diluted by the lymph contributes greatly to its lubricity, and the oil preſerves it from hardening. How well ſuch a mixture ſerves the purpoſe it is deſigned for *Boyle* (*a*) tells us he experienced in working his air-pump; for the ſucker could be moved with much leſs force after being moiſtened with water and oil, than when he uſed either one or other of theſe liquors: And I believe every one, at firſt view, will allow the diluted mucilage to be much preferable to ſimple water. The *ſynovia* (*b*), as this liquor compoſed of oil, mucilage, and lymph, is commonly now called, while in a ſound ſtate, effectually preſerves all the parts concerned in the articulations ſoft and flexible, and makes them ſlide, eaſily on each other, by which their mutual detrition and overheating is prevented, in the manner daily practiſed in coach and cart wheels, by beſmearing them with greaſe and tar.

After the liquor of the articulations becomes too thin and unſerviceable, by being conſtantly pounded and rubbed between the moving bones, it is reaſſumed into the maſs of blood by the abſorbent veſſels.

When the *ſynovia* is not rubbed betwixt the bones, it inſpiſſates. And ſometimes, when the

(*a*) Phyſico-mechanic experim.
(*b*) Μυξα mucus, axungia.

the head of a bone has been long out of its cavity, this liquor is said to fill up the place of the bone, and hinder its reduction; or if a joint continues long unmoved, it is also said to cement the bones, and occasion a true *anchylosis* (*a*).——If the *synovia* becomes too acrid, it erodes the cartilages and bones; as frequently happens to those who labour under the *lues venerea*, *scurvy*, *scrophula*, or *spina ventosa*. ——If this liquor is separated in too small quantity, the joint becomes stiff; and when with difficulty it is moved, a crackling noise is heard, as people advanced in years frequently experience (*b*).—If the mucilage and lympth are deposited in too great quantity, and the absorbent vessels do not perform their office sufficiently, they may occasion a dropsy of the joints (*c*).——From this same cause also the ligaments are often so much relaxed, as to make the conjunction of the bones very weak: Thence arise the luxations from an internal cause, which are easily reduced, but difficultly cured (*d*).——Frequently, when such a superfluous quantity of this liquor is pent up, it becomes very acrid, and occasions a great train of bad symptoms; such as swelling and pain of the joints, long sinuous ulcers and *fistulæ*, rotten bones, immobility of the joints, *marcor*

(*a*) Pare, Chirurgie, livre 15. chap. 18. et livre 16. chap. 5.

(*b*) Galen de usu part. lib. 12. cap. 2.——Fabric. ab Aquapend. de articul. part. utilitat. pars. 3——Bartholin. Hist. medic. cent. 3. hist. 11.

(*c*) Hildan. de ichore et mel iceria acri Celsi.

(*d*) Hippocrat. de locis in homine, Sec. 14. et de articul.

marcor and *atrophia* of the whole body, hectic fevers, *&c.* (*a*)——From a depravity in the blood or diſeaſes in the organs that furniſh the *ſynovia* of the joints, it may be greatly changed from its natural ſtate; it may be purulent after inflammation, mucous in the white ſwellings, gelatinous in the rheumatiſm, chalky from the gout, *&c.*; hence a great variety of diſorders in the joints (*b*).

THE

(*a*) Hildan. de ichore et meliceria acri Celſ.
(*b*) See Reimer Diſſert. de fungo articulor.

THE ANATOMY OF THE HUMAN BONES.

PART II.

Of the SKELETON.

THOUGH any dry ſubſtance may be called *ſkeleton*, yet, among anatomiſts, this word is univerſally underſtood to ſignify the bones of animals connected together, after the teguments, muſcles, bowels, glands, nerves, and veſſels are taken away *.

A ſkeleton is ſaid to be a *natural* one, when the bones are kept together by their own ligaments; and it is called *artificial*, when the bones are joined with wire, or any other ſubſtance which is not part of the creature to which they belonged. Small ſubjects, and ſuch whoſe bones are not fully oſſified, are commonly prepared the firſt way; becauſe, were all

* Cadaveris crates.

all their parts divided, the niceſt artiſt could not rejointhem, by reaſon of their ſmallneſs, and of the ſeparation of their unoſſified parts; whereas the bones of large adult animals are ſooneſt and moſt conveniently cleaned when ſingle, and are eaſily reſtored to, and kept in their natural ſituation.—Sometimes the ſkeleton of the ſame animal is prepared in both theſe ways; that is, the ſmaller bones are kept together by their natural ligaments, and the larger ones are connected by wires, or ſome ſuch ſubſtances.

Before we proceed to the diviſion and particular deſcription of the ſkeleton, it is worth while to remark, that when the bones are put into their natural ſituation, ſcarce any one of them is placed in a perpendicular bearing to another; though the fabric compoſed of them is ſo contrived, that, in an erect poſture, a perpendicular line, from their common center of gravity, falls in the middle of their common baſe (*a*). On this account, we can ſupport ourſelves as firmly, as if the axis of all the bones had been a ſtreight line perpendicular to the horizon; and we have much greater quickneſs, eaſe, and ſtrength in ſeveral of the moſt neceſſary motions we perform. It is true indeed, that where-ever the bones, on which any part of our body is ſuſtained, decline from a ſtreight line, the force required in the muſcles, to counteract the gravity of that part, is greater than otherwiſe it needed

(*a*) Cowper Anat. of human bodies, explic. of tab. 87. 88.

needed to have been: But then this is effectually provided for in such places by the number and strength of the muscles. So long therefore as we remain in the same posture, a considerable number of muscles must be in a constant state of contraction; which we know, both from reason and experience, must soon create an uneasy sensation. This we call, being weary of one posture: An inconvenience that we should not have had in standing erect, if the bearing of all the bones to each other had been perpendicular; but is more than compensated by the advantages above mentioned.

The human skeleton is generally divided into the HEAD, the TRUNK, the SUPERIOR and the INFERIOR EXTREMITIES.

OF THE HEAD.

BY the *HEAD* is meant all that spheroidal part which is placed above the first bone of the neck. It therefore comprehends the *cranium* and bones of the *face*.

The *cranium* *, helmet, or brain-case, consists of several pieces, which form a vaulted cavity, for lodging and defending the brain and *cerebellum*, with their membranes, vessels, and nerves.

The cavity of the *cranium* is proportioned to its contents. Hence such a variety of its size is observed in different subjects; and hence it is neither so broad nor so deep at its fore-

F part,

* Κεγχος, κύτος κώδεια, σκαφιον, calva, calvaria, cerebri galea, theca et olla capitis, testa capitis, scutella capitis.

part, in which the anterior lobes of the brain are lodged, as it is behind, where the large posterior lobes of the brain, and the whole *cerebellum*, are contained.

The roundish figure of the skull, which makes it more capacious, and better able to defend its contents from external injuries, is chiefly owing to the equal pressure of these contained parts as they grow and increase before it is entirely ossified.——It is to be observed, however, that the sides of the *cranium* are depressed below a spherical surface by the strong temporal muscles, whose action hinders here the uniform protrusion of the bones, which is more equally performed in other parts, where no such large muscles are. In children, whose muscles have not acted much, and consequently have not had great effects on the bones, this depression is not so remarkable; and therefore their heads are much rounder than in adults. These natural causes, differently disposed in different people, produce a great variety in the shapes of sculls, which is still increased by the different management of the heads of children when very young: So that one may know a *Turk's* skull by its globular figure, a *German's* by its breadth and flatness of the *occiput*, *Dutch* and *English* by their oblong shapes, *&c.* (*a*). Two advantages are reaped from this flatness of the sides of the *cranium*, *viz.* the enlargement of our sphere of vision, and more advantageous situation of our ears, for receiving a greater quantity of sound, and for being less exposed to injuries.

The

(*a*) Vesal. lib. 1. c. 5.

The external surface of the upper part of the *cranium* is very smooth, and equal, being only covered with the *periosteum*, (common to all the bones; but in the scull, distinguished by the name of *pericranium*), the thin *frontal* and *occipital* muscles, their tendinous *aponeurosis*, and with the common teguments of the body; while the external surface of its lower part has numerous risings, depressions, and holes, which afford convenient origin and insertion to the muscles that are connected to it, and allow safe passage for the vessels and nerves that run through and near it.

The internal surface of the upper part of the scull is commonly smooth, except where the vessels of the *dura mater* have made furrows in it, while the bones were soft.——Surgeons should be cautious when they trepane here, left, in sawing or raising the bone where such furrows are, they wound these vessels.——In the upper part of the internal surface of several sculls, there are likewise pits of different magnitudes and figures, which seem to be formed by some parts of the brain being more luxuriant and prominent than others. Where these pits are, the scull is so much thinner than any where else, that it is often rendered diaphanous, the two tables being closely compacted without a *diploe*; the want of which is supplied by vessels going from the *dura mater* into a great many small holes observable in the pits. These vessels are larger, and much more conspicuous than any others that are sent from the *dura mater* to the scull; as evidently appears from the drops of blood they pour out, when

the ſcull is raiſed from the *dura mater* in a recent ſubject; and therefore they may furniſh a ſufficient quantity of liquors neceſſary to prevent the brittleneſs of this thin part——The knowledge of theſe pits ſhould teach ſurgeons to ſaw cautiouſly and ſlowly through the external table of the ſcull, when they are performing the operation of the *trepan*; ſince, in a patient whoſe *cranium* has theſe pits, the *dura mater* and brain may be injured, before the inſtrument has pierced near the ordinary thickneſs of a table of the ſcull——The internal baſe of the ſcull is extremely unequal, for lodging the ſeveral parts and *appendices* of the brain and *cerebellum*, and allowing paſſage and defence to the veſſels and nerves that go into, or come out from theſe parts.

The bones of the *cranium* are compoſed of two tables, and intermediate *cancelli*, commonly called their *diploe* *. The external table is thickeſt; the inner, from its thinneſs and conſequent brittleneſs, has got the name of *vitrea*. Whence we may ſee the reaſon of thoſe miſchievous conſequences which ſo often attend a collection of matter in the *diploe*, either from an external or internal cauſe, before any ſign of ſuch a collection appears in the teguments that cover the part of the ſcull where it is lodged (*a*).

The *diploe* has much the ſame texture and uſes in the ſcull, as the *cancelli* have in other bones.

The

* Meditullium, commiſſura.

(*a*) Bonet. Sepulchret. anat. lib. 1. § 1. obſ. 96.—103.

The *diploe* of several old subjects is so obliterated, that scarce any vestige of it can be seen; neither is it observable in some of the hard craggy bones at the base of the scull. Hence an useful caution to surgeons who trust to the bleeding, want of resistance, and change of sound, as certain marks in the operation of the trepan, for knowing when their instrument has sawed through the first table, and reached the *diploe* (*a*). In other people, the *diploe* becomes of a monstrous thickness, while the tables of the scull are thinner than paper.

The *cranium* consists of eight bones, six of which are said to be proper, and the other two are reckoned common to it and to the face.—The six proper are, the *os frontis*, two *ossa parietalia*, two *ossa temporum*, and the *os occipitis*.——The common are the *os ethmoides* and *sphenoides*.

The *os frontis* forms the whole fore part of the vault; the two *ossa parietalia* form the upper and middle part of it; the *ossa temporum*, compose the lower part of the sides; the *os occipitis* makes the whole hinder part, and some of the base; the *os ethmoides* is placed in the fore part of the base, and the *os sphenoides* is in the middle of it.

These bones are joined to each other by five *sutures*; the names of which are, the *coronal*, *lambdoid*, *saggittal*, and two *squamous*.

The *coronal* * suture is extended over the head, from within an inch or so of the exter-

(*a*) Bartholin. Anat. reform. lib. 4 cap. 4.

* Στεφανεῖα, arcualis, puppis.

nal *canthus* of one eye, to the like distance from the other; which being near the place where the ancients wore their *vittæ*, *coronæ*, or garlands, this future has hence got its name.—Though the indentations of this future are conspicuous in its upper part, yet an inch or more of its end on each side has none of them; for it is squamous and smooth there.

The *lambdoidal* * future begins some way below, and farther back than the *vertex* or crown of the head, whence its two legs are stretched obliquely downwards, and to each side in form of the *Greek* letter Δ, and are now generally said to extend themselves to the *base*, of the scull; but formerly anatomists (*a*) reckoned the proper *lambdoid* future to terminate at the *squamous* sutures, and what is extended at an angle down from that on each side, where the indentations are less conspicuous than in the upper part of the future, they called *additamentum futuræ lambdoidis* †.

This *future* is sometimes very irregular, being made up of a great many small sutures, which surround so many little bones that are generally larger and more conspicuous on the external surface of the scull, than internally. These bones are generally called *triquetra* or *Wormiana*; but some other name ought to be given them, for they are not always of a triangular

* Laudæ, proræ, hypsyloides.

(*a*) Vesal. Anat. lib. 1. cap. 6.

† Lambdoides harmonialis, lambdoides inferior, occipitis corona.

gular figure; and older anatomists (*a*) than *Claus Wormius* (*b*) have described them.—The specific virtue which these bones were once thought to have in the cure of the epilepsy (*c*) is not now ascribed to them; and anatomists generally agree, that their formation is owing to a greater number of points than ordinary of ossification in the scull, or to the ordinary bones of the *cranium* not extending their ossification far enough or soon enough; in which case, the unossified interstice between such bones begins a separate ossification in one or more points: from which the ossification is extended to form as many distinct bones as there were points that are indented into the large ordinary bones, and into each other.—Probably those children who have a large opening in this place at their birth, will have the largest *ossa triquetra*.———To confirm this account of the formation of these little bones, we may remark, that such bones are sometimes seen in other sutures, as well as in the *lambdoid* (*d*), and they are sometimes in one table of the scull, and not in the other (*e*).

The *sagittal* suture * is placed longitudinally in the middle of the upper part of the scull, and

(*a*) Eustach. Ossium examen.—Bauhin Theat. anat. lib. 3. cap. 5.——Paaw in Hippocrat. de vulner. cap. p. 56.

(*b*) Musæum, lib. 3. cap. 26.

(*c*) Bauhin. et Paaw. ibid.—Bartholin. Anat. reform. lib. 4. cap 5.——Hildan. Epistol. 65.

(*d*) See Examples in Vesal. lib. 1. cap. 6. fig. 4.—Paaw in Hippocrat. de cap. vuln.—Bartholin. Hist. anat. cent. 1. hist. 51.—Rusch. Mus. anat.---Sue Trad. d'osteolog. p. 47.

(*e*) Hunald. in Mem. de l'acad. des sciences, 1730.

* Ῥαβδοειδὴς, ὀθελαία, ἐπιζευγνυσα, Instar virgæ, nervalis, instar teli, instar veru, secundum capitis longitudinem prorepens, conjungens, columnalis, recta, acualis.

and commonly terminates at the middle of the *coronal*, and of the *lambdoid* futures; between which it is ſaid to be placed, as an arrow is between the ſtring and bow.—However this future is frequently continued through the middle of the *os frontis*, down to the root of the noſe; which, ſome (*a*) ſay, oftener happens in women than men; but others (*b*) alledge, that it is to be met with more frequently in male ſculls than in female: Among the ſculls, which I have ſeen thus divided, the female are the moſt numerous ——Several (*c*) have delineated and deſcribed the *ſagittal* future, ſometimes dividing the *occipital* bone as far down as the great hole through which the *medulla ſpinalis* paſſes. This I never ſaw.

In ſome old ſculls that are in my poſſeſſion, there is ſcarce a veſtige of any of the three *futures* which I have now deſcribed. In other heads, one or two of the futures only diſappear; but I never could diſcover any reaſon for thinking them diſpoſed in ſuch different manners in ſculls of different ſhapes, as ſome antients alledge they are (*d*).

The *ſquamous agglutinations*, or *falſe futures* †, are one on each ſide, a little above the ear, of a ſemicircular figure, formed by the over-

(*a*) Riolan. Comment. de oſſib. cap. 8.

(*b*) Veſal. lib. 1. cap. 6. et in epitome.

(*c*) Veſal. lib. 1. cap. 5. fig 3, 4. et in text. cap. 6.——Paaw in Celſ. de re medic. cap. 1.—Laurent. Hiſt. anat. lib. 2 cap. 16.

(*d*) Hippocrat. de vulner. capitis, § 1.—Galen, de oſſib. et de uſu part. lib. 9. cap. 17.

† Δεπιδοειδῆ, προσκολλήματα, κροταφιαι, temporales, corticales, mendoſæ, harmoniales, commiſſuræ in unguem.

overlopping (like one ſcale upon another) of the upper part of the *temporal* bones on the lower part of the *parietal*, where, in both bones, there are a great many ſmall rilings and furrows, which are indented into each other; though theſe inequalities do not appear till the bones are ſeparated. In ſome ſculls indeed the indentations here are as conſpicuous externally as in other ſutures (*a*); and what is commonly called the poſterior part of this ſquamous ſuture, always has the evident ſerrated form; and therefore is reckoned by ſome (*b*), a diſtinct ſuture, under the name of *additamentum poſterius ſuturæ ſquamoſæ*.——I have ſeen too ſquamous ſutures on the ſame temple, with a ſemicircular piece of bone between them (*c*).

We ought here to remark, that the true ſquamous ſort of ſuture is not confined to the conjunction of the temporal and parietal bones, but is made uſe of to join all the edges of the bones on which each temporal muſcle is placed (*d*): For the two parts of the ſphenoidal ſuture which are continued from the anterior end of the common ſquamous ſuture juſt now deſcribed, of which one runs perpendiculary downwards, and the other horizontally forwards, and alſo the lower part of the coronal ſuture already taken notice of, may all be juſtly ſaid to pertain

(*a*) Columb. de re anat. lib. 1. cap. 4.—Dionis, Anat. 3. demonſt. des os.
(*b*) Albin. de oſſib. § 54.
(*c*) Sue Trad. d'oſteolog. p. 48.
(*d*) Veſal. Anat. lib. 1. cap. 6.——Winſlow, Mem. de l'acad. des ſciences, 1710.

pertain to the squamous *future*—The manner how I imagine this sort of future is formed at these places, is, That by the action of the strong temporal muscles on one side, and by the pressure of the brain on the other, the bones are made so thin, that they have not large enough surfaces opposed to each other to stop the extension of their fibres in length, and thus to cause the common serrated appearance of futures explained in p. 39. but the narrow edge of the one bone slides over the other. The *squamous* form is also more convenient here; because such thin edges of bones, when accurately applied one to another, have scarce any rough surface, to obstruct or hurt the muscle in its contraction; which is still further provided for, by the manner of laying these edges on each other; for in viewing their outside, we see the temporal bones covering the sphenoidal and parietal, and this last supporting the sphenoidal, while both mount on the frontal: from which disposition it is evident, that while the temporal muscle is contracting, which is the only time it presses strongly in its motion on the bones, its fibres slide easily over the external edges. Another advantage still in this is, that all this bony part is made stronger by the bones thus supporting each other.

The bones of the scull are joined to those of the face, by *schyndelesis* and *futures*.—The *schyndelesis* is in the partition of the nose—The futures said to be common to the *cranium* and face are five, viz. the *ethmoidal*, *sphenoidal*, *transverse*, and two *zygomatic*.—Parts however

ever of these sutures are at the junction of only the bones of the scull.

The *ethmoidal* and *sphenoidal* sutures surround the bones of these names; and in some places help to make up other sutures, particularly the *squamous* and *transverse*; and in other parts there is but one suture common to these two bones.

The *transverse* suture is extended quite cross the face, from the external *canthus* of one orbit to the same place of the other, by sinking from the *canthus* down the outside of the orbit to its bottom; then mounting upon its inside, it is continued by the root of the nose down the internal part of the other orbit, and rises up again on its outside to the other *canthus*. It may be here remarked, that there are some interruptions of this suture in the course I have described; for the bones are not contiguous every where, but are separated, to leave holes and apertures, to be mentioned hereafter.

The *zygomatic* sutures are one on each side, being short, and slanting from above obliquely downwards and backwards, to join a process of the cheek-bone to one of the *temporal* bones, which advances towards the face; so that the two processes thus united, form a sort of bridge, or *jugum*, under which the *temporal* muscle passes; on which account the processes, and suture joining them, have been called *zygomatic*.

It must be observed, that the indentations of the *sutures* do not appear on the inside of the *cranium*, by much so strong as on the out-side; but the bones seem almost joined in a streight line;

line; nay, in some sculls, the internal surface is found entire, while the futures are manifest without; which may possibly be owing to the less extent of the concave than of the convex surface of the *cranium*, whereby the fibres of the internal side would be stretched farther out at the edges of the bones, than the exterior ones, if they were not resisted. The resistances are the fibres of the opposite bone, the parts within the scull, and the *diploe*; of which the last being the weakest, the most advanced fibres or *serræ* run into it, and leave the contiguous edges equal, and more ready to unite: whereas the *serræ* of the external table have space enough for their admission between the fibres of the opposite bone, and therefore remain of the indented form, and are less liable to the concretion, whereby the futures are obliterated (*a*).——By this mechanism, there is no risk of the sharp points of the bones growing inwards, since the external *serræ* of each of the conjoined bones rest upon the internal smooth edged table of the other; and external forces applied to these parts are strongly resisted, because the futures cannot yield, unless the serrated edges of the one bone, and the plain internal plate of the other are broken (*b*).

The advantages of the futures of the *cranium* are these: 1. That this *capsula* is more easily formed and extended into a spherical figure, than if it had been one continued bone. 2. That

(*a*) Hunauld, Memoires de l'acad. des sciences, 1730.
(*b*) Winslow, Memoires de l'acad. des sciences, 1720.

2. That the bones which are at some distance from each other at birth, might then yield, and allow to the head a change of shape, accommodated to the passage it is engaged in. Whence, in hard labour of child-bed, the bones of the *cranium*, instead of being only brought into contact, are sometimes made to mount one upon the other. 3. It is alledged, that, thro' the sutures, there is a transpiration of steams from the brain, which was the old doctrine; or some communication of the vessels without, and of those within the scull, larger here than in any other part of the *cranium*, according to some moderns; and therefore *cucuphæ*, *fomentations*, *cataplasms*, *cephalic plaisters*, *blisters*, are applied, and *issues* are eroded, or cut in the head, at those places where the sutures are longest in forming, and where the connection of the bones is afterwards loosest, for the cure of a *phrenitis*, *mania*, *inveterate headach*, *epilepsy*, *apoplexy*, and other diseases of the head. The favourers of the doctrine of transpiration, or communication of vessels at the sutures, endeavour to support it by observations of persons subject to head-achs which caused death, from the sutures being too closely united (*a*). 4. That the *dura mater* may be more firmly suspended by its processes, which insinuate themselves into this conjunction of the bones; for doing this equally, and where the greatest necessity of adhesion is, the sutures are disposed at nearly

G equal

(*a*) Columb. de re anat. lib. 1. cap. 5.——Verduc. nouvelle osteologie, chap. 14.——Dionis, Anat. 3. demonstr. des os.

equal distances, and the large *reservoirs* of blood, the *sinuses*, are under or near them. 5. That fractures might be prevented from reaching so far as they would in a continued bony substance. 6. That the connection at the sutures being capable of yielding, the bones might be allowed to separate; which has given great relief to patients from the violent symptoms which they had before this separation happened (*a*). And it seems reasonable to believe, that the opening of the sutures was of great benefit to several others who were rather judged to have been hurt by it (*b*): for we must think, that the consequences of such a force acting upon the brain, as was capable of thrusting the bones asunder, must have been fatal, unless it had been thus yielded to.

Having gone through the general structure of the *cranium*, I now proceed to examine each bone of which that brain-case consists, in the order in which I first named them.

The *OS FRONTIS* † has its name from its being the only bone of that part of the face we call the *forehead*, though it reaches a good deal further. It has some resemblance in shape to the shell of the *concha bivalvis*, commonly called

(*a*) Ephemerid. Germanic. dec. 1. ann. 4. et 5. observ. 33.

(*b*) Ephemerid. Germ. dec. 2. ann. 9. obs. 230. Ibid. cent. 10. obs. 31.---Vander Linden Medicin. phys. cap. 8. art. 4. § 16.---Hildan, Observ. cent. 1. obs. 1. cent. 2. obs. 7.---Bauchin. Theat. anat. lib. 3. cap. 6. --Pechlin. Observ. lib. 2. observ. 39.

† Μετώπη, Βρέγμα, coronale, inverecundum, puppis, sensus communis, sincipitis.

called the *cockle;* for the greateſt part of it is convex externally, and concave internally, with a ſerrated circular edge; while the ſmaller part has proceſſes and depreſſions, which make it of an irregular figure.

The external ſurface of the *os frontis* is ſmooth at its upper convex part; but ſeveral proceſſes and cavities are obſervable below: for, at each angle of each orbit, the bone jutts out, to form four proceſſes, two internal, and as many external; which, from this ſituation, may well enough be named *angular*. Between the internal and external angular proceſſes of each ſide, an arched ridge is extended, on which the eye brows are placed.——Very little above the internal end of each of theſe *ſuperciliary* ridges, a protuberance may be remarked, in moſt ſculls, where there are large cavities, called *ſinuſes*, within the bone; of which hereafter.—Betwixt the internal angular proceſſes, a ſmall proceſs riſes, which form ſome ſhare of the noſe, and thence is named *naſal*.——Some obſerve a protuberant part on the edge of the bone behind each external angular proceſs, which they call *temporal* proceſſes; but theſe are inconſiderable.——From the under part of the ſuperciliary ridges, the frontal bone runs a great way backwards; which parts may juſtly enough be called *orbitar* proceſſes. Theſe, contrary to the reſt of this bone, are concave externally, for receiving the globes of the eyes, with their muſcles, fat, *&c.*

In each of the *orbitar* proceſſes, behind the middle of the ſuperciliary ridges, a conſiderable ſinuoſity is obſerved, where the *glandula*

innominata Galeni or *lachrymalis* is lodged.—Behind each internal angular proceſs, a ſmall pit may be remarked, where the cartilaginous pully of the *muſculus obliquus major* of the eye is fixed.——Betwixt the two orbitar proceſſes, there is a large diſcontinuation of the bone, into which the cribriform part of the *os ethmoides* is incaſed.—The frontal bone frequently has little caverns formed in it here where it is joined to the ethmoid bone.——Behind each external angular proceſs, the ſurface of the frontal bone is conſiderably depreſſed where part of the *temporal* muſcle is placed.

The *foramina*, or holes, obſervable on the external ſurface of the frontal bone, are three in each ſide. —— One in each ſuperciliary ridge, a little removed from its middle towards the noſe; through which a twig of the *ophthalmic* branch of the fifth pair of nerves paſſes out of the orbit, with a ſmall artery from the internal carotid, to be diſtributed to the teguments and muſcles of the forehead.—— Theſe veſſels in ſome ſculls make furrows in the *os frontis*, eſpecially in the bones of children, as has alſo been obſerved of another conſiderable veſſel of this bone near its middle (*a*); and therefore we ought to beware of tranſverſe inciſions on either ſide of the *os frontis*, which might either open theſe veſſels or hurt the nerves, while they are yet in part within the bone; for, when veſſels are thus wounded, it is difficult to ſtop the hæmorrhagy, becauſe the adheſion of a part of the artery to the bone hinders its contraction,

(*a*) Ruyſch. Muſ. anat. theca D. repoſit. 4. No. 3.

contraction, and consequently styptics can have little effect; the sides of the furrow keep off compressing substances from the artery; and we would wish to shun cauteries or escharotics, because they make the bone carious; and nerves, when thus hurt, sometimes produce violent symptoms.—But, to return to the *superciliary foramina*, we must remark, that often, instead of a hole, a notch only is to be seen: Nay, in some sculls, scarce a vestige even of this is left; in others, both hole and notch are observable, when the nerve and artery run separately. Frequently a hole is found on one side, and a notch on the other; at other times we see two holes; or there is a common hole without, and two distinct entries internally. The reason of this variety of a hole, notch, depression, or smoothness in the superciliary ridge, is the different length and tension of the nerves and vessels; the shorter they are, the more they are sunk into the bone as it grows.—Near the middle of the inside of each orbit; hard by, or in the *transverse suture*, there is a small hole for the passage of the nasal twig of the first branch of the fifth pair of nerves, and of a branch of the ophthalmic artery. This hole is sometimes entirely formed in the *os frontis*; in other sculls, the sides of it are composed of this last bone, and of the *os planum*. It is commonly known by the name of *orbitarium internum*, though *anterius* should be added, because of the next, which is commonly omitted.——This, which may be called *orbitarium internum posterius*, is such another as the former; only smaller, and about an

inch deeper in the orbit: through it a small branch of the ocular artery passes to the nose.—Besides these six, there are a great number of small holes observable on the outer surface of this bone, particularly in the two protuberances above the eye-brows. Most of these penetrate no further than the *sinuses*, or than the *diploe*, if the *sinuses* are wanting; though sometimes I have seen this bone so perforated by a vast number of these small holes, that, placed between the eye and a clear light, it appeared like a sieve.——In the orbit of the generality of *skeletons*, we may observe one, two, or more holes, which allow a passage to a hog's bristle through the scull. The place, size, and number of these, are however uncertain: They generally serve for the transmission of small arteries or nerves.

The internal surface of the *os frontis* is concave, except at the orbitar processes, which are convex, to support the anterior lobes of the brain. This surface is not so smooth as the external; for the larger branches of the arteries of the *dura mater* make some furrows in its sides and back parts. The sinuosities from the luxuriant risings of the brain, mentioned when describing the general structure of the *cranium*, are often very observable on its upper part; and its lower and fore parts are marked with the contortions of the anterior lobes of the brain.——Through the middle of this internal surface, where always in children, and sometimes in old people, the bone is divided, either a ridge stands out, to which the upper edge of the *falx* is fastened, or a furrow runs, in which

which the upper ſide of the ſuperior longitudinal *ſinus* is lodged; on both theſe accounts chirurgical authors juſtly diſcharge the application of the trepan here.—The reaſon of this difference in ſculls, is alledged by ſome authors to be this. That in thin ſculls the ridge ſtrengthens the bones, and in thick ones there is no occaſion for it. To this way of accounting for this phœnomenon, it may juſtly be objected, that generally very thick ſculls have a large ſpine here, and frequently thin ones have only a furrow. Perhaps this variety may be owing to the different times of compleat oſſification of thoſe parts in different ſubjects; for if the two ſides of this bone meet before they arrive at their utmoſt extent of growth, they unite very firmly, and all their fibres endeavour to ſtretch themſelves out where the leaſt reſiſtance is, that is, between the hemiſpheres of the brain. To ſupport this reaſoning, we may remark, that thoſe adults, whoſe frontal bone is divided by the ſagittal future, never have a ridge in this place.

Immediately at the root of this ridge or furrow there is a ſmall hole, which ſometimes pierces through the firſt table, and, in other ſculls, opens into the ſuperior *ſinus* of the *ethmoid* bone within the noſe. In it a little proceſs of the *falx* is lodged, and a ſmall artery, and ſometimes a vein runs (*a*); and the ſuperior longitudinal *ſinus* begins here.—This hole, however, is often not entirely proper to the *os frontis*; for in ſeveral ſculls, the lower part of it is formed in the upper part of the baſe of the *criſta*

(*a*) Morgagn. Adverſar. 6. animad. 31.

crista galli, which is a process of the *ethmoid* bone (*a*).

The *os frontis* is composed of two tables, and an intermediate *diploe*, as the other bones of the *cranium* are, and, in a middle degree of thickness between the *os occipitis* and the *parietal* bones; is pretty equally dense all through, except at the orbitar processes, where, by the action of the eye on one side, and pressure of the lobes of the brain on the other, it is made extremely thin and diaphanous, and the *meditullium* is entirely obliterated. Since in this place there is so weak a defence for the brain, the reason appears why fencers esteem a push in the eye mortal (*b*).

The *diploe* is also exhausted in that part above the eye-brows, where the two tables of the bone separate, by the external being protruded outwards, to form two large cavities, called *sinus frontales*.—These are divided by a middle perpendicular bony partition——Their capacities in the same subject are seldom equal; in some the right, in others the left is largest.—And in different bones their size is as inconstant; nay, I have examined some, where they were entirely wanting; which oftener happens in such as have a flat fore-head, and whose sagittal suture is continued down to the nose, than in others (*c*).—In some sculls, besides the large perpendicular *septum*, there are several bony

(*a*) Ingrafi, Comment. in Galen. de ossib. cap. 1. comment. 8.

(*b*) Ruysch Observ. anat. chir. observ. 54.--Diemerbroeck. Anat. lib. 3. cap. 10.---Bonet. Sepulch. anat. lib. 4. § 3. observ. 17.

(*c*) Fallop. Exposit. de ossibus, cap. 13.

bony pillars, or short partitions, found in each *sinus*; in others these are wanting.——For the most part the *septum* is entire; at other times it is discontinued, and the two *sinuses* communicate.—When the *sinuses* are seen in such sculls as have the frontal bone divided by the sagittal suture, the partition dividing these cavities is evidently composed of two plates, which easily separate.——Each *sinus* commonly opens by a roundish small hole, at the inner and lower part of the internal angular processes, into a *sinus* formed in the nose, at the upper and back part of the *os unguis*; near to which there are also some other small *sinuses* of this bone (*a*), the greater part of which open separately nearer the *septum narium*, and often they terminate in the same common canal with the large ones.

In a natural and sound state, these cavities are of considerable advantage: for the organ of smelling being thus enlarged, the *effluvia* of odorous bodies more difficultly escape it; and their impressions being more numerous, are therefore stronger, and affect the organ more. That odorous particles may be applied to the membrane of the *sinuses*, is evident from the pain felt in this part of the forehead, when the *effluvia* of volatile spirits or of strong aromatics, are drawn up into the nose by a quick inspiration.——These and the other cavities which open into the nose, increase the sound of our voice, and render it more melodious, by serving as so many vaults to resound the notes. Hence people labouring under a *coryza*, or stoppage of the nose from any other

(*a*) Cowper in Drake's Anthropolog. book 3. chap. 10.

other cauſe, when they are by the vulgar, tho' falſely, ſaid to ſpeak through their noſe, have ſuch a diſagreeable harſh voice.—The liquor ſeparated in the membrane of theſe ſinuſes, drills down upon the membrane of the noſe to keep it moiſt.

From the deſcription of theſe *ſinuſes*, it is evident, how uſeleſs, nay, how pernicious it muſt be, to apply a trepan on this part of the ſcull; for this inſtrument, inſtead of peircing into the cavity of the *cranium*, would reach no further than the *ſinuſes*; or, if the inner table was perforated, any extravaſated blood that happened to be within the ſcull, would not be diſcharged outwardly, but would fall into the *ſinuſes*, there to ſtagnate, corrupt, and ſtimulate the ſenſible membranes; from which alſo there would be ſuch a conſtant flow of glairy mucus, as would retard, if not hinder a cure, and would make the ſore degenerate into an incurable *fiſtula*. Beſides, as it would be almoſt impoſſible in this caſe to prevent the air, paſſing through the noſe, from having conſtant acceſs to the *dura mater*, or brain; ſuch a corruption would be brought on theſe parts as would be attended with great danger. Further, in reſpiration, the air ruſhing violently into theſe cavities of the *os frontis*, and paſſing through the external orifice, whenever it was not well covered and defended, would not only prevent the cloſing up of the external orifice, but might otherwiſe bring on bad conſequences (*a*).—The membrane lining theſe *ſinuſes*

(*a*) Paaw, de oſſibus, pars. 1. cap. 7.---Palfyne Anatom. chir. traite 4. chap. 15. Nouvelle oſteologie, partie 2. chap. 3.

sinuses is so sensible, that inflammations of it must create violent torture (*a*); and worms, or other insects crawling there, must give great uneasiness (*b*).

The upper circular part of the *os frontis*, is joined to the *ossa parietalia*, from one temple to the other, by the coronal suture. From the termination of the coronal suture, to the external angular processes, this bone is connected to the *sphenoid* by the *sphenoidal* suture. At the external *canthi* of the eyes, its angular processes are joined by the transverse suture to the *ossa malarum*, to which it adheres one third down the outside of the orbits; whence to the bottom of these cavities, and a little up on their internal sides, these orbitar processes are connected to the *sphenoidal* bone by that same suture.—In some few sculls, however, a discontinuation of these two bones appears at the upper part of the long slit, near the bottom of the orbit.—On the inside of each orbit, the orbitar process is indented between the *cribriform* part of the *ethmoid* bone, and the *os planum* and *unguis*.—The transverse suture afterwards joins the frontal bone to the superior nasal processes of the *ossa maxillaria superiora*, and to the nasal bones. And, *lastly*, its nasal-process is connected to the nasal *lamella* of the *ethmoid* bone.

The

(*a*) Fernel. Partholog. lib. 5. cap. 7.--Saltzman Decur. observ. 10.

(*b*) Fernel. Partholog. lib. 5. cap. 7.--Bartholin. Epistol. medic. cent. 2. epist. 74. --Hist. de l'acad. des sciences, 1708 & 1733.

The *frontal* bone ſerves to defend and ſupport the anterior lobes of the brain. It forms a conſiderable part of the cavities that contain the globes of the eyes, helps to make up the *ſeptum narium*, organ of ſmelling, *&c.* From the deſcription of the ſeveral parts, the other uſes of this bone are evident.

In a ripe child, the frontal bone is divided through the middle; the ſuperciliary holes are not formed; often a ſmall round piece of each orbitar proceſs, behind the ſuperciliary ridge, is not oſſified, and there is no *ſinus* to be ſeen within its ſubſtance.

Each of the two *OSSA PARIETALIA* *, or bones ſerving as walls to the *encephalon*, is an irregular ſquare; its upper and fore ſides being longer than the one behind or below. The inferior ſide is a concave arch; the middle part receiving the upper round part of the temporal bone.—The angle formed by this upper ſide, and the fore one, is ſo extended, as to have the appearance of a proceſs.

The external ſurface of each *os parietale* is convex. Upon it, ſomewhat below the middle height of the bone, there is a tranſverſe arched ridge, of a whiter colour generally than any other part of the bone; from which, in bones that have ſtrong prints of muſcles, we ſee a great many converging furrows, like ſo many *radii* drawn from a circumference towards a center. From this ridge of each bone the temporal muſcle riſes; and, by the preſſure of its fibres, occaſions the furrows juſt now mentioned.

* Κορυφῆς, paria, ſynciptis, verticis, arcualia, nervalia cogitationis, rationis, bregmatis, madefactionis.

mentioned ——Below these, we observe near the semicircular edges, a great many risings and depressions, which are joined to like inequalities on the inside of the temporal bone, to form the squamous suture. The temporal bone may therefore serve here as a buttress, to prevent the lower side of the parietal from starting outwards when its upper part is pressed or struck (*a*).

Near the upper sides of these bones, towards the hind part, is a small hole in each, through which a vein passes from the teguments of the head to the longitudinal *sinus*. Sometimes I have seen a branch of the temporal artery pass through this hole, to be distributed to the upper part of the *falx*, and to the *dura mater* at its sides, where it had frequent anastomoses with the branches of the arteries derived from the external carotids, which commonly have the name of the arteries of the *dura mater*, and with the branches of the internal carotids which serve the *falx*.—In several sculls, one of the *ossa parietalia* has not this hole: in others, there are two in one bone; and in some not one in either. Most frequently this hole is through both tables; at other times the external table is only perforated.—The knowledge of the course of these vessels, may be of use to surgeons, when they make any incision near this part of the head, least if the vessels are rashly cut near the hole, they shrink within the substance of the bone, and so cause an obstinate hæmorrhagy, which neither ligatures nor medicines can stop.

(*a*) Hunauld in Mem. de l'acad. des sciences, 1730.

On the innner concave ſurface of the parietal bones, we ſee a great many deep furrows, diſpoſed ſomewhat like the branches of trees: The furrows are largeſt and deepeſt at the lower edge of each *os parietale*, eſpecially near its anterior angle, where ſometimes a full canal is formed. They afterwards divide into ſmall furrows, in their progreſs upwards.—In ſome ſculls a large furrow begins at the hole near the upper edge, and divides into branches, which join with thoſe which come upwards, ſhewing the communications of the upper and lower veſſels of the *dura mater*.—In theſe furrows we frequently ſee paſſages into the *diploe*; and ſometimes I have obſerved canals going off, which allowed a ſmall probe to paſs ſome inches into the bony ſubſtance. Some (*a*) tell us, that they have obſerved theſe canals piercing the bone towards the *occiput*.—On the inſide of the upper edge of the *oſſa parietalia*, there is a large ſinuoſity, frequently larger in the bone of one ſide than of the other, where the upper part of the *falx* is faſtened, and the ſuperior longitudinal *ſinus* is lodged.—Generally part of the lateral *ſinuſes* makes a depreſſion near the angle, formed by the lower and poſterior ſides of theſe bones; and the pits made by the prominent parts of the brain are to be ſeen in no part of the ſcull more frequent, or more conſiderable, than in the internal ſurface of the parietal bones.

The *oſſa parietalia* are amongſt the thinneſt bones of the *cranium*; but enjoy the general ſtructure

(*a*) Cowper. Anatom. explic. of 90. tab. fig. 2.

ſtructure of two tables and *diploe* the completeſt, and are the moſt equal and ſmooth.

Theſe bones are joined at their fore-ſide to the *os frontis* by the coronal ſuture; at their long inferior angles, to the *ſphenoid bone*, by part of the ſuture of this name; at their lower edge, to the *oſſa temporum*, by the ſquamous ſuture, and its poſterior *additamentum*; behind, to the *os occipitis*, or *oſſa triquetra*, by the lambdoid ſuture; and above, to one another, by the ſagittal ſuture.

They have no particular uſes beſides thoſe mentioned in the deſcription of their ſeveral parts, except what are included in the account of the general ſtructure of the *cranium*.

In a child born at the full time, none of the ſides of this bone are compleated; and there never is a hole in the oſſified part of it near to the ſagittal ſuture.

The large unoſſified ligamentous part of the *cranium* obſervable between the parietal bones, and the middle of the divided *os frontis* of new-born children, called by the vulgar the *open of the head*, was imagined by the antients to ſerve for the evacuation of the ſuperfluous moiſture of the brain; and therefore they named it *bregma* *, or the fountain; ſometimes adding the epiphet *pulſatilis*, or beating, on account of the pulſation of the brain felt through this flexible ligamento-cartilaginous ſubſtance. Hence very frequently the parietal bones are called *oſſa bregmatis*.

The upper middle part of the head of a child, in a natural birth, being what preſents

* Palpitans vertex, foliolum, folium, triangularis lacuna.

itself first at the *os uteri* (*a*), an accoucheur may reach the *bregma* with his finger, when the *os uteri* is a little opened. If the *bregma* is stretched, and the pulsation of the brain is felt through it, the child is certainly alive: But if it is shrivelled and flaccid, without any observable pulsation in it, there is some reason to suspect the child to be very weak, or dead. Those who practise midwifery should therefore examine the state of the *bregma* accurately.

All the *bregma* is generally ossified before seven years of age. Several authors (*b*) say, they have observed it unossified in adults; and physicians, who order the application of medicines at the meeting of the coronal and sagittal sutures, seem yet to think that a derivation of noxious humours from the *encephalon* is more easily procured at this part than any other of the scull; and that medicines have a greater effect here, than elsewhere, in the internal disorders of the head.

OSSA TEMPORUM *, so named, say authors, from the hair's first becoming gray on the temples, and thus discovering peoples ages, are each of them equal and smooth above, with a very thin semicircular edge; which, from the manner of its connection with the neighbouring bones, is distinguished by the name

(*a*) Burton's Midwifery, § 51.---Smellie's Midwifery, book 1. chap. 1. § 5.

(*b*) Bartholin. Anat. reform. lib. 4. cap. 6.----Diemerbroek Anat. lib. 9. cap. 6.---Kerkring. Osteogen. cap. 2.

* Κόρταφῶν, κορσῶν, κορρῶν, λεπιδοειδῆ, πολυειδῆ, λιθοειδῆ. temporalia, lapidosa, mendosa, dura, arcualia, tymparum, armalia, saxea, parietalia.

name of *os squamosum*.——Behind this the upper part of the temporal bone is thicker, and more unequal, and is sometimes described as a distinct part, under the name of *pars mammillaris* (*a*).——Towards the base of the scull, the temporal bone appears very irregular and unequal; and this part, instead of being broad, and placed perpendicularly, as the others are, is contracted into an oblong very hard substance, extended horizontally forwards and inwards, which in its progress becomes smaller, and is commonly called *os petrosum*.

Three external processes of each temporal bone are generally described—The first placed at the lower and hind part of the bone, from its resemblance to a nipple, is called *mastoides*, or *mammillaris*. It is not solid, but within is composed of *cancelli*, or small cells, which have a communication with the large cavity of the ear, the drum; and therefore sounds, being multiplied in this vaulted labyrinth, are increased, before they are applied to the immediate organ of hearing. Into the mastoid process, the *sternomastoideus* muscle is inserted; and to its back part, where the surface is rough, the *trachelomastoideus*, and part of the *splenius* are fixed.—About an inch farther forward, the second process begins to rise out from the bone; and having its origin continued obliquely downwards and forwards for some way, it becomes smaller; and is stretched forwards to join with the *os malæ*; they together forming the bony *jugum*, under which the temporal muscle passes.

(*a*) Albin de ossib. § 16.

Hence this proceſs has been named *zygomatic*.* Its upper edge has the ſtrong aponeuroſis of the *temporal* muſcle fixed into it; and its lower part gives riſe to a ſhare of the *maſſeter*.—— The fore part of the baſe of this proceſs is an oblong tubercle, which in a recent ſubject is covered with a ſmooth poliſhed cartilage, continued from that which lines the cavity immediately behind this tubercle.———from the under craggy part of the *os temporum*, the third proceſs ſtands out obliquely forwards. The ſhape of it is generally ſaid to reſemble the ancient *ſtylus ſcriptorius*: and therefore it is called the *ſtyloid* proceſs†. Some authors (*a*) however contend, that it ought to be named *ſteloid*, from its being more like to a pillar. Several muſcles have their origin from this proceſs, and borrow one half of their name from it; as *ſtylo-gloſſus*, *ſtylo-hyoideus*, *ſtylo-pharyngeus*; to it a ligament of the *os hyoides* is ſometimes fixed; and another is extended from it to the inſide of the angle of the lower jaw. This proceſs is often even in adults not entirely oſſified, but is ligamentous at its root, and ſometimes is compoſed of two or three diſtinct pieces ———Round the root of it, eſpecially at the fore-part, there is a remarkable riſing of the *os petroſum*, which ſome have eſteemed a proceſs; and, from the appearance

* Καγχρος, paris, anſæ oſſium temporum, oſſa arcuata, paria, jugalia, conjugalia.

† Γραφειοειδη, βελονοειδη, πληκτρον, os calaminum, ſagittale, clavale, acuale, calcar capitis.

(*a*) Galen, de uſu part. lib. 2. cap 4.——Fallop. obſerv. anatom.

pearance it makes with the *ſtyliform*, have named it *vaginalis*.——Others again have, under the name of *auditory* proceſs, reckoned among the external proceſſes that ſemicircular ridge, which, running between the root of the *maſtoid* and *zygomatic* proceſſes, forms the under-part of the external *meatus auditorius*.

The ſinuoſities or depreſſions on the external ſurface of each *os temporum* are theſe:——A long *foſſa* at the inner and back part of the root of the mammary proceſs, where the poſterior head of the *digaſtric* muſcle has its origin.—Immediately before the root of the *zygomatic* proceſs, a conſiderable hollow is left, for lodging the *crotaphite* muſcle.——Between the *zygomatic*, *auditory*, and *vaginal* proceſſes, a large cavity is formed; through the middle of which, from top to bottom, a fiſſure is obſervable, into which part of the ligament that ſecures the articulation of the lower jaw with this bone is fixed. The fore-part of the cavity being lined with the ſame cartilage which covers the tubercle before it, receives the *condyle* of the jaw; and in the back part a ſmall ſhare of the parotid gland, and a cellular fatty ſubſtance, are lodged.——At the inſide of the root of the *ſtyloid apophyſe*, there is a thimble like cavity, where the beginning of the internal jugular vein, or end of the lateral *ſinus* is lodged.—And as the ſinuſes of the two ſides are frequently of unequal ſize; ſo one of theſe cavities is as often larger than the other (*a*).—Round the external *meatus auditorius*, ſeveral ſinuoſities are formed for receiving the cartilages

(*a*) Hunauld. in Mem. de l'acad. des ſciences, 1730.

tilages and ligaments of the ear, and for their firm adhesion.

The *holes* that commonly appear on the outside of each of these bones, and are proper to each of them, are five.——The *first*, situated between the *zygomatic* and *mastoid* processes, is the orifice of a large funnel-like canal, which leads to the organ of hearing; therefore is called *meatus auditorius externus**.—— The *second* gives passage to the *portia dura* of the seventh pair of nerves, and from its situation between the *mastoid* and *styloid* processes, is called *foramen stylo mastoideum* †.—Some way before, and to the inside of the *styloid* process, is the *third* hole; the canal from which runs first upwards, then forwards, and receives into it the internal *carotid* artery, and the beginning of the intercostal nerve; where this canal is about to make the turn forwards, one, or sometimes two very small holes go off towards the cavity of the ear called *tympanum*: through these *Valsalva* (*a*) affirms the proper artery or arteries of that cavity are sent.—On the anterior edge of this bone, near the former, a *fourth* hole is observable, being the orifice of a canal which runs outwards and backwards, in a horizontal direction, till it terminates in the *tympanum*. This, in the recent subject, is continued forward and inward, from the parts which I mentioned just now as its orifice in the skeleton, to the side of the nostrils; being partly cartilaginous, and partly ligamentous. The whole

* Πόρος της ακοης, οπή των ὠτῶν, fenestra aurium.
† Aquaeductus Fallopii
(*a*) De aure humana, cap. 2. § 22. et tab. 7. fig. 1.

whole canal is named, *Iter a palato ad aurem*, or *Euſtachian tube*.—On the external ſide of the bony part of this canal, and a-top of the chink in the cavity that receives the *condyle* of the lower jaw, is the courſe of the little nerve ſaid commonly to be reflected from the lingual branch of the fifth pair, till it enters the *tympanum*, to run acroſs this cavity, and to have the name of *chorda tympani*.——The *fifth* hole is very uncertain, appearing ſometimes behind the *maſtoid* proceſs; ſometimes it is common to the temporal and occipital bones; and in ſeveral ſculls there is no ſuch hole. The uſe of it, when found, is for the tranſmiſſion of a vein from the external teguments to the lateral *ſinus*: But, in ſome ſubjects, a branch of the occipital artery paſſes through this hole, to ſerve the back part of the *dura mater*; in others, I have ſeen two or three ſuch holes: But they are oftener wanting than found. And we may, once for all, in general remark, That the largeneſs, number, ſituation, and exiſtence of all ſuch holes, that for the moſt part allow only a paſſage for veins from without to the internal receptacles, are very uncertain.

The internal ſurface of the *oſſa temporum* is unequal; the upper circular edge of the ſquamous part having numerous ſmall ridges and furrows for its conjunction with the parietal bones; and the reſt of it is irregularly marked with the convolutions of the middle part of the brain, and with furrows made by the branches of the arteries of the *dura mater*.

From the under part of this internal ſurface, a larger tranſverſe hard craggy protuberance runs

runs horizontally inwards and forwards, with a ſharp edge above, and two flat ſides, one facing obliquely forwards and outwards, and the other as much backwards and inwards. To the ridge between theſe two ſides, the large lateral proceſs of the *dura mater* is fixed.

Sometimes a ſmall bone, a-kin to the ſeſamoid, is found between the ſmall end of this *petrous* proceſs and the *ſphenoid* bone (*a*).

Towards the back-part of the inſide of the *os temporum*, a large deep *foſſa* is conſpicuous, where the *lateral ſinus* lies; and frequently on the top of the *petrous* ridge, a furrow may be obſerved, where a ſmall ſinus is ſituated.

The internal proper *foramina* of each of theſe bones are, *firſt*, the internal *meatus auditorius* in the poſterior plain ſide of the petrous proceſs. This hole ſoon divides into two; one of which is the beginning of the *aquæduct* of *Fallopius*; the other ends in ſeveral very ſmall canals (*b*) that allow a paſſage to the branches of the *portio mollis* of the ſeventh pair of nerves, into the *veſtibule* and *cochlea*. Through it alſo an artery is ſent, to be diſtributed to the organ of hearing.——The *ſecond* hole, which is on the anterior plain ſide of the craggy proceſs, gives paſſage to a reflected branch of the ſecond branch of the fifth pair of nerves, which joins the *portio dura* of the auditory nerve, while it is in the *aquæduct* (*c*), ſmall

(*a*) Riolan. Comment. de oſſib. cap. 32.——Winſlow, Expoſition anatomique de corps humain, trait. des os ſecs. § 266.

(*b*) Valſalv. De aure humana, cap. 3. § 11.

(*c*) Valſalv. De aure, cap. 3. § 10.

small branches of blood veſſels accompanying the nerves or paſſing through ſmaller holes near this one.—The paſſage of the cutaneous vein into the lateral *ſinus*, or of a branch of the occipital artery, is ſeen about the middle of the large *foſſa* for that *ſinus*; and the orifice of the canal of the *carotid* artery is evident at the under part of the point of the *petrous* proceſs.

Beſides theſe proper holes of the temporal bones which appear on their external and internal ſurfaces, there are two others in each ſide that are common to this bone and to the *occipital* and *ſphenoidal* bones; which ſhall be mentioned afterwards in the deſcription of theſe bones.

The upper round part of the ſquamous bones is thin, but equal; while the low petrous part is thick and ſtrong, but irregular and unequal, having the diſtinction of tables and *diploe* confounded, with ſeveral cavities, proceſſes, and bones within its ſubſtance, which are parts of the organ of hearing. That a clear idea may be had of this beautiful, but intricate organ, anatomiſts generally chuſe to demonſtrate all its parts together. I think the method good; and therefore, ſince it would be improper to inſert a compleat treatiſe on the ear here, ſhall omit the deſcription of the parts contained within the *os petroſum* of the ſkeleton.

The temporal bones are joined above to the parietal bones by the ſquamous ſutures, and their poſterior *adamenta*: Before, to the *ſphenoid* bone by the ſuture of that name; to the

cheek-

cheek-bones by the *zygomatic* ſutures: Behind, to the *occipital* bone, by the *lambdoid* ſuture and its *additamenta*; and they are articulated with the *lower jaw* in the manner which ſhall be deſcribed when this bone is examined.

The purpoſes which theſe two bones ſerve, are eaſily collected, from the general uſe of the *cranium*, and from what has been ſaid in the deſcription of their ſeveral parts.

In an infant, a ſmall fiſſure is to be obſerved between the thin upper part, and the lower craggy part of each of theſe bones; which points out the recent union of theſe parts.—— Neither *maſtoid* nor *ſtyloid* proceſſes are yet to be ſeen.—Inſtead of a bony funnel like external *meatus auditorius*, there is only a ſmooth bony ring, within which the membrane of the drum is faſtened.——At the entry of the *Euſtachian tube*, the ſide of the *tympanum* is not completed.——A little more outward than the internal auditory canal, there is a deep pit, over the upper part of whoſe orifice the interior ſemicircular canal of the ear is ſtretched; and ſome way below this, the poſterior ſemicircular canal alſo appears manifeſtly.

*OS OCCIPITIS**, ſo called from its ſituation, is convex on the outſide, and concave internally. Its figure is an irregular ſquare, or rather *rhomboid*; of which the angle above is generally a little rounded; the two lateral angles are more finiſhed, but obtuſe; and the lower one is ſtretched forward in form of a wedge, and thence is called by ſome the *cuneiform*

* Ἰνιον, baſilare, proræ, memoriæ, pixidis, fibroſum, nervoſum, lambde.

form proceſs—If one would, however, be very nice in obſerving the ſeveral turns which the edges of the *os occipitis* make, five or ſeven ſides and as many angles of this bone might be deſcribed.

The external ſurface is convex, except at the cuneiform apophyſe, where it is flatted. At the baſe of this triangular proceſs, on each ſide of the great hole, but more advanced forwards than the middle of it, the large oblong protuberances, named the *condyles*, appear, to ſerve for the articulation of this bone with the firſt *vertebra* of the neck. The ſmooth ſurface of each of theſe *condyloid* proceſſes is longeſt from behind forwards, where, by their oblique ſituation, they come much nearer to each other than they are at their back part. Their inner ſides are lower than the external, by which they are prevented from ſliding to either ſide out of the cavities of the firſt *vertebra* (*a*). In ſome ſubjects each of theſe plain ſmooth ſurfaces ſeems to be divided by a ſmall riſing in its middle; and the lower edge of each condyle, next the great *foramen*, is diſcontinued about the middle, by an interveening notch: Whence ſome (*b*) alledge, that each of theſe *apophyſes* is made up of two protuberances.—Round their root a ſmall depreſſion and ſpongy roughneſs is obſervable, where the ligaments for ſurrounding and ſecuring their articulations adhere.—Though the motion of the head is performed on the condyles, yet the center of gravity of that globe does not fall

(*a*) Galen. de uſu part lib. 12. cap. 7.
(*b*) Diemerbroeck, anat. lib. 9. cap. 6.

between them, but is a good way further forward; from which mechaniſm it is evident, that the muſcles which pull the head back, muſt be in a conſtant ſtate of contraction; which is ſtronger than the natural contraction of the proper flexors, elſe the head would always fall forwards, as it does when a man is aſleep, or labours under a palſy, as well as in infants, where the weight of the head far exceeds the proportional ſtrength of theſe muſcles. This ſeeming diſadvantageous ſituation of the condyles is however of good uſe to us, by allowing ſufficient ſpace for the cavities of the mouth and *fauces*, and for lodging a ſufficient number of muſcles, which commonly ſerve for other uſes; but may at pleaſure be directed to act on the head, and then have an advantageous lever to act with, ſo as to be able to ſuſtain a conſiderable weight appended, or other force applied, to pull the head back.

Somewhat more externally than the *condyles* there is a ſmall riſing and ſemilunated hollow in each ſide, which make part of the holes, common to the *occipital* and *petrous* bones.—Immediately behind this, on each ſide, a ſcabrous ridge is extended from the middle of the condyle, towards the root of the *maſtoid* proceſs. Into this ridge the *muſculus lateralis*, commonly aſcribed to *Fallopius*, is inſerted.—About the middle of the external convex ſurface, a large arch runs croſs the bone; from the upper lateral parts of which the *occipital* muſcles have their riſe; to its middle the *trapezii* are attached: and half way between this and the great hole, a leſſer arch is extended.—In the

hollows

hollows between the middle of these arches the *complexi* are inserted; and in the depressions more external and further forward than these, the *splenii* are inserted.—Between the middle of the lesser arch and the great hole, the little hollow marks of the *recti minores* appear; and on each side of these the fleshly insertions of the *obliqui superiores* and *recti majores* make depressions.—Through the middle of the two arches a small sharp *spine* is placed, which serves as some sort of partition between the muscles of different sides, or rather is owing to the action of the muscles depressing the bone on each side of it, while this part is free from their compression.—These prints of the muscles on this bone are very strong and plain in some subjects, but are not so distinct in others.—All round the great *foramen* the edges are unequal, for the firmer adhesion of the strong circular ligament which goes thence to the first *vertebra*.—One end of each *lateral* or *moderator* ligament of the head, is fixed to a rough surface at the fore part of each condyle, and the *perpendicular* one is connected to a rough part of the edge of the great hole between the two condyles.—Immediately before the condyles, two little depressions are made in the external surface of the cuneiform process, for the insertion of the *recti anteriores minores* muscles which are unjustly ascribed to *Cowper*: and still further forward, near the *sphenoid* bone, are two other such depressions, for the reception of the *recti anteriores majores*.—When we consider the size of the prints of muscles on the

occipital bone, before and behind its condyles, and at the same time, compare their distances from these centers of motion of the head, we must see how much stronger the muscles are which pull the head backwards, than those are which bend it forward; and how much greater force the former acquire by the long lever they act with, than the latter which are inserted so near the condyles. This great force in the extensor muscles is altogether necessary, that they might not only keep the head from falling forward in an erect posture, but that they might support it when we bow forward in the most necessary offices of social life, when the weight of the head comes to act at right angles on the *vertebræ* of the neck, and obtains a long lever to act with.

On the inner surface of the *os occipitis* we see two ridges; one standing perpendicular, the other running horizontally across the first. The upper part of the perpendicular limb of the cross, to which the *falx* is fixed, is hollowed in the middle, or often on one side, for the reception of the *superior longitudinal sinus*, and the lower part of it has the small or third process of the *dura-mater* fastened to it, and is sometimes hollowed by the *occipital sinus*. Each side of the horizontal limb is made hollow by the lateral sinuses inclosed in the transverse process of the *dura mater*; the *fossa* in the right side being generally a continuation of the one made by the longitudinal sinus in the perpendicular limb, and therefore is larger than the left one (*a*) ——Round the middle of the cross

(*a*) Morgagn. Adverf. anat. 6. animad. 1.

croſs there are four large depreſſions ſeparated by its limbs; the two upper ones being formed by the back part of the brain, and the two lower ones by the *cerebellum*.——Farther forward than the laſt mentioned depreſſions, is the lower part of the *feſſa* for the lateral *ſinus* on each ſide.——The inner ſurface of the cuneiform apophyſe is made concave for the reception of the *medulla oblongata*, and of the *baſilar* artery.—A furrow is made on each ſide, near the edges of this proceſs, by a *ſinus* of the *dura mater*, which empties itſelf into the lateral *ſinus* (*b*).

The holes of this bone are commonly five proper, and two common to it and to the *temporal* bones.—The firſt of the proper holes, called *foramen magnum* * from its ſize, is immediately behind the wedge-like proceſs, and allows a paſſage to the *medulla oblongata*, *nervi acceſſorii*, to the vertebral arteries, and ſometimes to the vertebral veins.——At each ſide of this great hole, near its fore part, and immediately above the condyles; we always find a hole, ſometimes two, which ſoon unite again into one that opens externally; thro' theſe the ninth pair of nerves go out of the ſcull.—The fourth and fifth holes pierce from behind the *condyle* of each ſide into the *foſſæ* of the lateral *ſinuſes*; they ſerve for the paſſage of the cervical veins to theſe *ſinuſes*. Often one of theſe holes is wanting, ſometimes both, when the veins paſs thro' the great *foramen*.—Beſides theſe five, we frequently meet with other holes near the edges of this bone, for the

(*a*) Albin. de oſſib. § 65.
* Rachitidis, Medullæ ſpinalis.

transmission of veins; but their number and diameter are very uncertain. The two common *foramina* are the large irregular holes, one in each side, between the sides of the *cuneiform* process, and the edges of the *petrous* bones. In a recent subject, a strong membrane runs cross from one side to the other of each of these holes; in some heads I have seen this membrane ossified, or a bony partition dividing each hole; and in the greater number of adult sculls, there is a small sharp-pointed process stands out from the *os petrosum*, and a more obtuse rising in the occipital bone, between which the partition is stretched. Behind this partition, where the largest space is left, the *lateral sinus* has its passage; and before it the eight pair of nerves and *accessorius* make their exit out of the scull; and some authors say, an artery passes through this hole, to be bestowed on the *dura mater*.

The *occipital* bone is among the thickest of the *cranium*, though unequally so; for it is stronger above, where it has no other defence than the common teguments, than it is below, where being pressed by the lobes of the brain and *cerebellum* on one side, and by the action of the muscles on the other, it is so very thin, as to be diaphanous in many sculls: But then these muscles ward off injuries, and the ridges and spines, which are frequent here, make it sufficiently strong to resist ordinary forces. The tables and *diploe* are tolerably distinct in this bone, except where it is so thin as to become diaphanous.

The

The occipital bone is joined above to the *ossa parietalia* and *triquetra* when present, by the *lambdoid* future;———laterally to the temporal bones, by the *additamenta* of the *lambdoid* future;——below to the *sphenoid* bone, by the end of its cuneiform process, in the same way that epiphyses and their bones are joined: For in children a ligamentous cartilage is interposed between the occipital and sphenoid bones, which gradually turns thinner, as each of the bones advances, till their fibres at last run into each other; and, about sixteen or eighteen years of age, the union of these two bones becomes so intimate, that a separation cannot be made without violence.——The *os occipitis* is joined by a double articulation to the first *vertebra* of the neck, each condyle being received into a superior oblique process of that *vertebra*. What motion is allowed here, we shall consider afterwards, where the *vertebræ* are described.

The uses of this bone appear from the preceeding description, and therefore need not be repeated.

An infant born at the full time, has this bone divided, by unossified cartilages, into four parts.——The first of these is larger than the other three, is of a triangular shape, and constitutes all the part of the bone above the great *foramen*. Generally fissures appear in the upper part and sides of this triangular bone, when all the cartilage is separated by maceration; and sometimes little distinct bones are seen towards the edges of it.—The second and third pieces of this bone are exactly alike, and situated

ſituated on each ſide of the great *foramen*; from which very near the whole condyles are produced; and they are extended forwards almoſt to the fore part of the hole for the ninth pair of nerves ——The fourth piece is the cuneiform proceſs, which forms a ſmall ſhare of the great hole, and of theſe for the ninth pair of nerves, and of the condyles: betwixt it and the *ſphenoid* bone, a cartilage is interpoſed.

Of the eight bones which belong to the *cranium*, there are only two which are not yet deſcribed, *viz.* the *ethmoid* and *ſphenoid*. Theſe we already mentioned, in complaiſance to the generality of writers on this ſubject, as bones common to the *cranium* and face, becauſe they enter into the compoſition of both: but the ſame reaſon might equally be uſed for calling the frontal bone a common one too. I ſhall, however, paſs any idle diſpute about the propriety of ranging them, and proceed to examine the ſtructure of the bones themſelves.

OS ETHMOIDES *, or the ſieve-like bone, has got its name from the great number of ſmall holes with which that part of it firſt taken notice of is pierced. When this bone is entire, the figure of it is not eaſily deſcribed; but, by a detail of its ſeveral parts, ſome idea may be afforded of the whole; and therefore I ſhall diſtinguiſh it into the *cribriform lamella* with its proceſs, the *naſal lamella*, *cellulæ*, and *oſſa ſpongioſa*.

The thin horizontal *lamella*, is all (except its back part) pierced obliquely by a great number of ſmall holes, through which the filaments

* Cribriforme, σπολγοειδὲς, ſpongiforme, criſtatum.

ments of the olfactory nerves pass. In a recent subject, these holes are so closely lined by the *dura mater*, that they are much less conspicuous than in the *skeleton*.——From the middle of the internal side of this plate, a thick process rises upwards, and, being highest at the fore part, gradually becomes lower, as it is extended backwards. From some resemblance which this process was imagined to have to a cock's comb, it has been called *crista galli* *, The *falx* is connected to its ridge, and to the unperforated part of the cribriform plate.—— When the *crista* is broke, its base is sometimes found to be hollow, with its cavity opening into the nose (*a*).——Immediately before the highest part of this process, is the blind hole of the *frontal* bone, which, as was formerly remarked, is often in a good measure formed by a notch in the fore part of the root of the *crista*.

From the middle of the outer surface of the *cribriform lamella*, a thin solid plate is extended downwards and forwards, having the same common base with the *crista galli*. Generally it is not exactly perpendicular, but is inclined to one side or other, and therefore divides the cavity of the nose unequally. Its inclination to one side, and flexure in the middle, is sometimes so great, that it fills up a large share of one of the nostrils, and has been mistook for a *polypus* there.—It is thin at its rise, and rather still thinner in its middle; yet afterwards, towards its lower edge, it becomes thicker, that

* Verruca praedura, septum ossis spongiosi.
(*a*) Palsyn Anat. chir. tr. 4. chap. 15.

that its conjunction with the bones and middle cartilage of the nose might be firmer.

At a little distance from each side of this external process, a cellular and spongy bony substance depends from the cribriform plate. The number and figure of the cells in this irregular process of each side, are very uncertain, and not to be represented in words; only the cells open into each other, and into the cavity of the nose: The uppermost, which are below the aperture of the frontal *sinuses*, are formed like funnels.——The outer surface of these cells is smooth and plain, where this bone assists in composing the orbit; at which place, on each side, it has got the name of *os planum*; on the upper edge of which, a small notch or two may sometimes be observed, which go to the formation of the internal orbitar holes; as was remarked in the description of the frontal bone.

Below the cells of each side, a thin plate is extended inwards, and then bending down, it becomes thick and of a spongy texture.——This spongy part is triangular, with a streight upper edge placed horizontally, an anterior one slanting from above, downwards and forwards, and with a pendulous convex one below.—The upper and lower edges terminate in a sharp point behind.—The side of this pendulous spongy part next to the *septum narium* is convex, and its external side is concave.——These two processes of the *ethmoid* bone have got the name of *ossa spongiosa*, or *turbinata superiora*, from their substance, figure, and situation.

All

All the prominences, cavities and *meanders* of this *ethmoid* bone, are covered with a continuation of the membrane of the noſtrils, in a recent ſubject.——Its horizontal cribriform plate is lodged between the orbitar proceſſes of the *frontal* bone, to which it is joined by the *ethmoid* ſuture, except at the back-part where it is connected with the *cuneiform* bone, by a ſuture common to both theſe bones, though it is generally eſteemed part of the *ſphenoidal*.——Where the *oſſa plana* are contiguous to the frontal bone within the orbit, their conjunction is reckoned part of the tranſverſe ſuture.——Farther forward than the *oſſa plana*, the cells are covered by the *oſſa unguis*, which are not only contiguous to theſe cells, but cannot be ſeparated from them, without breaking the bony ſubſtance; and therefore, in juſtice, thoſe bones ought to be demonſtrated as part of the *ethmoid* bone.——Below the *oſſa unguis* and *plana*, theſe cells and *oſſa ſpongioſa* are overlopped by the *maxillary* bones.——The cellular part of each *palate* bone is contiguous to each *os planum* and cells backwards.—The lower edge of the naſal perpendicular plate is received into the furrow of the *vomer*.——Its poſterior edge is joined to the fore-part of the *proceſſus azygos* of the *ſphenoid* bone.——Its upper edge joins the *naſal* proceſs of the *frontal* and *naſal* bones, and its anterior one is connected to the middle cartilage of the noſe.

From all which, the uſes of this bone are evident, *viz.* to ſuſtain the anterior lobes of the brain; to give paſſage to the olfactory nerves, and attachment to the *falx*; to enlarge the organ

organ of ſmelling, by allowing the membrane of the noſe a great extent; to ſtraiten the paſſage of the air through the noſe, by leaving only a narrow winding canal, on the ſenſible membranous ſides of which the ſubſtances conveyed along with the air muſt ſtrike; to form part of the orbit of the eyes and *ſeptum narium*; while all its parts are ſo light as not to be in hazard of ſeparating by their weight; and they are ſo thin, as to form a large ſurface, without occupying much ſpace. This brittle ſubſtance, however, is ſufficiently protected from external injuries by the firm bones which cover it.

If this bone is ſeized on by any corroding matter, we may eaſily conceive what deſtruction may enſue. Hence it is, that an *ozaena* is difficult to cure; and that, in violent *ſcurvies* or in the *lues venerea*, the fabric of the noſe, the eyes, and life itſelf are in danger.—The ſituation of the naſal plate may ſhew us, how dangerous a fracture of the bones of the noſe may be, when made by a force applied to their middle fore part, of a perſon in whom this naſal plate is perpendicular.

The *ethmoid* bone of ripe children is divided into two by a perpendicular cartilage, which, when oſſified, is the *criſta galli*, and naſal plate: but its other parts are oſſified and complete.

*OS SPHENOIDES**, or wedge-like bone, ſo called becauſe of its ſituation in the middle

* Cuneiforme, πολυμορφον, multiforme, paxillum, eribratum palati, colatorii, cavilla, baſilare.

middle of the bones of the *cranium* and face is of such an irregular figure, that I know not any thing to which it may be likened, unless, perhaps, it bear some faint resemblance to a bat with its wings extended.

When we view the external surface of the *os sphenoides*, two or three remarkable processes from each side of it may be observed, which are all of them again subdivided.—The first pair is the two large lateral processes or wings; the upper part of each of which is called the *temporal process*, because they join with the temporal bones in forming the temples, and the seat for some share of the *crotaphite* muscles. That part of the wings which juts out towards the inside, somewhat lower than the temporal *apophyses*, and is smooth and hallowed, where it makes up part of the orbit, is thence named *orbitar processes*. Behind the edge, separating these two processes, there is often a small groove, made by a branch of the superior maxillary nerve, in its passage to the temporal muscle. The lowest and back part of each wing, which runs out sharp to meet the *ossa petrosa*, has been styled the *spinous* process: From near the point of which a sharp pointed process is frequently produced downwards, which some call *styliform*, that affords origin to the *ptery-staphylinus externus* muscle. From this styloid process a very small groove is extended along the edge of the bone to the hollow at the root of the internal plate of the following processes, which

forms part of the *Euſtachian* tube (*a*).—The ſecond pair of external proceſſes of the *cuneiform* bone is the two which ſtand out almoſt perpendicular to the baſe of the ſcull. Each of them has two plates, and a middle *foſſa* facing backwards, and ſhould, to carry on our compariſon, be likened to the bat's legs, but are commonly ſaid to reſemble the wings of that creature; and therefore are named *pterygoid* or *aliform* * proceſſes. The external plates are broadeſt, and the internal are longeſt. From each ſide of the external plates the *pterygoid* muſcles take their riſe. At the root of each internal plate, a ſmall hollow may be remarked, where the *muſculus ptery-ſtaphylinus internus*, or *circumflexus palati* riſes, and ſome ſhare of the cartilaginous end of the *Euſtachian* tube reſts; and, at the lower end of the ſame plate, is a hook-like riſing or proceſs, round which the tendon of the laſt-named muſcle plays, as on a pulley. From the edge of the external plate ſome ſmall ſharp ſpikes ſtand out; but their number and bulk are uncertain. To theſe another pair may be added, to wit, the little triangular thin proceſs, which comes from each ſide of the body of the *ſphenoid* bone, where the *pterygoid* proceſſes are riſing from it, and are extended over the lower part of the aperture of the *ſinus* as far as to join the *ethmoid* bone, while their body hangs

(*a*) Winſlow, Expoſition anatomique du corps humain, traite des os ſecs, § 233.

* Naviculares.

hangs down into the *nares* (*a*).—Beſides theſe pairs of proceſſes, there is a ſharp ridge which ſtands out from the middle of its baſe: Becauſe it wants a fellow, it may be called *proceſſus azygos*. The lower part of this proceſs, where it is received into the *vomer*, is thick, and often not quite perpendicular, but inclining more to one ſide than the other. The fore-part of this proceſs, where it joins the naſal plate of the *os ethmoides*, is thin and ſtreight. Theſe two parts have been deſcribed as two diſtinct proceſſes by ſome,

The depreſſions, ſinuoſities, and *foſſæ*, on the external ſurface of this *ſphenoid* bone, may be reckoned up to a great number, *viz.* two on the temporal *apophyſes* where the *crotaphite* muſcles lodge.—Two on the *orbitar* proceſſes, to make way for the globes of the eyes.——Two between the *temporal* and *ſpinous* proceſſes, for receiving the temporal bones.——Two between the plates of the *pterygoid* proceſſes, where the *muſculi pterygoidei interni* and *ptery ſtaphylini interni* are placed.——Two between the *pterygoid* and *orbitar* proceſſes, for forming the holes common to this and to the *cheek* and *maxillary* bones. Two on the lower ends of the *ahform* proceſſes, which the *palate* bones enter into.——Two at the roots of the *temporal* and *pterygoid* proceſſes, where the largeſt ſhare of the external *pterygoid* muſcles have their riſe.——Two at the ſides of the *proceſſus azygos*, for forming part of the noſe, *&c.*

What I deſcribed under the name of *tempo-*

(*a*) Albin. Tab. oſſ. 5. fig 2. 6. A A.——Bertin Mem. de l'acad des ſciences 1744.—Suc. planche viii. fig. 2, 3. 4. 5. 6.

ral and *spinous processes* on the out-side of the scull, are likewise seen on its inside, where they are concave, for receiving part of the brain; and commonly three *apophyses* on the internal surface of the *sphenoid* bone are only mentioned.——Two rising broad from the fore-part of its body, become smaller as they are extended obliquely backwards.——The third standing on a long transverse base, near the back-part of the body of this bone, rises nearly erect, and of an equal breadth, terminating often in a little knob on each side. The three are called *clinoid*, from some resemblance which they were thought to have to the supporters of a bed. Sometimes one or both the anterior *clinoid* processes are joined to the sides of the posterior one, or the body of the bone itself.——From the roots of the anterior *clinoid* processes the bone is extended on each side outwards and forwards, till it ends in a sharp point, which may have the name of the *transverse spinous* processes.——Between, but a little farther back than the two anterior *clinoid* processes, we see a protuberance considerably smaller than the posterior *clinoid* process, but of its shape.—Another process from between the transverse processes, often forces itself forwards into the *os ethmoides*.

Within the scull, there are two sinuosities in the internal part of each wing of the *sphenoid* bone, for receiving the middle part of the brain.——One between the transverse spinous processes, for lodging the part of the brain where the *crura medullæ oblongatæ* are.—Immediately before the third or middle *clinoid* process,

proceſs, a ſingle pit generally may be remarked, from which a *foſſa* goes out on each ſide to the holes through which the optic nerves paſs. The pit is formed by the conjoined optic nerves; and in the *foſſæ* theſe nerves are lodged, as they run divided within the ſcull.—Between that third protuberance and the poſterior *clinoid* proceſs, the larger pit for the *glandula pituitaria* may be remarked. This cavity, becauſe of its reſemblance to a *Turkiſh* ſaddle, is always deſcribed under the name of *ſella Turcica*, or *ephippium*——On the ſides of the poſterior *clinoid* proceſs a *foſſa* may be remarked, that ſtretches upwards, then is continued forwards along the ſides of the *ſella Turcica*, near to the anterior *clinoid* proceſſes, where a pit on each ſide is made. Theſe *foſſæ* point out the courſe of the two internal *carotid* arteries, after they have entered the ſcull.—Beſides all theſe, ſeveral other *foſſæ* may be obſerved, leading to the ſeveral holes, and imprinted by the nerves and blood-veſſels.

The holes on each ſide of the *os ſphenoides* are ſix proper, and three common.——The *firſt* is the round one immediately below the anterior *clinoid* proceſſes, for the paſſage of the optic nerve, and of the branch of the internal *carotid* artery that is ſent to the eye.——The *ſecond* is the *foramen lacerum*, or large ſlit between the tranſverſe ſpinous and orbitar proceſſes: The interior end of which ſlit is large; and, as it is extended outwards, it becomes narrower. The outer end of it is formed in the *os frontis*; and therefore this might be reckoned among the common *foramina*.

Through it the third, fourth, the first branch of the fifth, and the greater share of the sixth pair of nerves, and an artery from the internal carotid, go into the orbit. Sometimes a small branch of the external carotid enters near its end, to be distributed to the *dura mater (a)*. and a vein, some call it the *venous duct*, or, *Nuck's aquæduct*, returns through it to the cavernous *sinus*.——The *third* hole, situated a little below the one just now described, is called *rotundum*, from its shape. It allows passage to the second branch of the fifth pair of nerves, or superior maxillary nerve, into the bottom of the orbit.—— The *fourth* is the *foramen ovale*, about half an inch behind the round hole. Through it the third branch of the fifth pair, or inferior *maxillary* nerve, goes out; and sometimes a vein from the *dura mater* passes out here (*b*).—Very near the point of the spinous process is the *fifth* hole of this bone: It is small and round, for a passage to the largest artery of the *dura mater*, which often is accompanied with a vein.——The *sixth* proper hole (*c*) cannot be well seen, till the cuneiform bone is separated from all the other bones of the *cranium*; for one end of it is hid by a small protuberance of the internal plate of the *pterygoid* process, and by the point of the *processus petrosus*

(*a*) Winslow, Exposition anatomique du corps humain, traite des arteries, § 60. et de la téte, § 26.

(*b*) Ingrass. Commentar. in Galen. de ossib. lib. 1. comment. 8.

(*c*) Vesal. Anat. lib. 1. cap. 12.——Eustach. tab. 46. fig. 13. & 16.—Vidus Vidius, Anat. lib. 2. cap. 2. explicat. tab. 5. & tab. 5. fig. 8. 9. 10. lit. O.

petrosus of the *temporal* bone. Its canal is extended above the inner plate of the *pterygoid* process; and where it opens into the cavity of the nose, it is concealed by the thin laminous part of the *palate* bone. Through it a considerable branch of the second branch of the *fifth* pair of nerves is reflected.———Often in the middle of the *sella Turcica* a small hole or two pierce as far as the cellular substance of the bone; and sometimes at the sides of this *sella*, one or more small holes penetrate into the *sphenoidal sinuses*. These observations afforded some anatomists (*a*) an argument of weight in their days in defence of *Galen* (*b*), who asserted the descent of the *pituita* that way into the *sinuses* below.

The *first* of the common holes is that unequal fissure at the side of the *sella Turcica*, between the extreme point of the *os petrosum* and the *spinous* process of the cuneiform bone. This hole only appears after the bones are boiled; for in a recent subject its back part is covered by a thin bony plate that lies over the internal carotid artery, and further forward it is filled with a cartilaginous ligament, under which the cartilaginous part of the *Eustachian tube* is placed: It was by this passage that the ancients believed the *slimy matter* was conveyed from the eumunctory of the brain, the *glandula pituitaria*, to the *fauces*.—The *second* common hole is the large discontinuation of the external side of the orbit, left between the orbitar processes

(*a*) Jac. Sylv. Calumniæ secundæ amolitio.—Laurent. Hist. anat. lib. 2. quest. 11.

(*b*) Galen. De usu part. lib. 9. cap. 1.

proceſſes of the cuneiform bone, the *os maxillare*, *malæ*, and *palati*. In this large hole the fat for lubricating the globe of the eye and temporal muſcle is lodged, and branches of the ſuperior maxillary nerve, with ſmall arteries from the carotid and veins paſs—The *third* hole is formed between the baſe of this bone and the root of the orbitar proceſs of the palate bone of each ſide. Through this a branch of the external carotid artery, and of the ſecond branch of the fifth pair of nerves, are allowed a paſſage to the noſtrils, and a returning vein accompanies them. Sometimes, however, this hole is proper to the palate bone, being entirely formed out of its ſubſtance.

Under the *ſella Turcica*, and ſome way further forward, but within the ſubſtance of the *ſphenoid* bone, are two *ſinuſes*, ſeparated by a bony plate. Each of them is lined with a membrane, and opens into the upper and back-part of each noſtril by a round hole, which is at their upper fore part. This hole is not formed only by the *os ſphenoides*, which has an aperture near as large as any tranſverſe ſection of the *ſinus*, but alſo by the *palate* bones which are applied to the fore part of theſe *ſinuſes*, and cloſe them up, that hole only excepted, which was already mentioned. Frequently the two *ſinuſes* are of unequal dimenſions, and ſometimes there is only one large cavity, with an opening into one noſtril. Theſe cavities are likewiſe ſaid (*a*) to be extended ſometimes as far back as the great *foramen* of the occipital bone. In other ſubjects

(*a*) Albin. de oſſib. § 39.

jects they are not to be found, when the bone is compoſed of large cells (*a*). Some (*b*) mention a cavity within the partition of the *ſinuſes*; but it is ſmall —The *ſphenoidal ſinuſes* ſerve the ſame uſes as the frontal do.

As this bone is extremely ragged and unequal, ſo its ſubſtance is of very different thickneſs, being in ſome places diaphanous; in others it is of a middle thickneſs, and its middle back part ſurpaſſes the greateſt ſhare of the *cranium* in thickneſs.

The *os ſphenoides* is joined, by its wings, to the *parietal* bones above, to the *os frontis* and *oſſa malarum* before, to the *temporal* bones behind;——By the fore part of its body and ſpinous proceſſes, to the *frontal* and *ethmoid* bones;—by its back part, behind the two *ſinuſes*, to the *occipital*, where it looks like a bone with the *epiphyſes* taken off, and, as was formerly obſerved in the deſcription of the occipital bone, it cannot be ſeparated without violence in adults;——to the *palate* bones, by the ends of the *pterygoid* proceſſes, and ſtill more by the fore-part of the internal plates of the *pterygoid* proceſſes, and of the *ſinuſes*;—to the *maxillary* bones, by the fore-part of the external *pterygoid* plates;—to the *vomer* and naſal plate of the *os ethmoides*, by the *proceſſus azygos*. All theſe conjunctions, except the laſt, which is a *ſchindyleſis*, are ſaid to be by the future proper to this bone; though it is at firſt ſight evident, that ſeveral other futures, as

(*a*) Veſal. lib. 1. cap. 6.
(*b*) Id. ibid.

as the *transverse, ethmoidal, &c.* are confounded with it.

We see now how this bone is joined to all the bones of the *cranium*, and to most of the upper jaw; and therefore obtained the name of the *wedge like bone*.

The uses are so blended with the description, as to leave nothing new to be added concerning them.

The *sphenoidal* bone is almost compleat in a *fœtus* of nine months; only the great *alæ* separate after maceration from the body of the bone.—The *processus azygos* is very large and hollow;—the thin triangular processes are not ossified——the internal surface of the body is unequal and porous;———the *sinuses* do not appear.

Whoever is acquainted with each bone of the *cranium*, can, without difficulty, examine them as they stand united, so as to know the shapes, sizes, distances, *&c.* of their several parts, and the forms, capacities, *&c.* of the cavities formed by them, which is of great use towards understanding the anatomy of the parts contiguous to, contained within, or connected to them. Such a review is necessary, after considering each class of bones. Thus the orbits, nostrils, mouth, face, head, spine, *thorax pelvis*, trunk, extremities, and skeleton, ought likeways to be examined.

The *FACE* is the irregular pile of bones, composing the fore and under part of the head, which is divided, by authors, into the upper and lower *maxillæ* or jaws.

The

The *superior maxilla* * is the common designation given to the upper immoveable share of the face; though, if we would follow *Celsus (a)*, we should apply the word *maxilla* to the lower jaw only, and the name *malla* to this upper jaw. In complaisance to prevailing custom, I shall, however, use the terms as now commonly employed. The shape of the superior jaw cannot easily be expressed; nor is it necessary, provided the shape and situation of all the bones which compose it are described. It is bounded above by the transverse suture, behind by the fore-part of the *sphenoid* bone, and below by the mouth.

The upper jaw consists of six bones on each side, of a thirteenth bone which has no fellow, placed in the middle, and of sixteen teeth. The thirteen bones are two *ossa nasi*, two *ossa unguis*, two *ossa malarum*, two *ossa maxillaria*, two *ossa palati*, two *ossa spongiosa inferiora*, and the *vomer*.

The *ossa nasi* are placed at the upper part of the nose;——the *ossa unguis* are at the internal *canthi* of the orbits;——*ossa malarum* form the prominence of the cheeks;——*ossa maxillaria* form the side of the nose, with the whole lower and fore part of the upper jaw, and the greatest share of the roof of the mouth;—*ossa palati* are situated at the back-part of the palate, nostrils, and orbit;—*ossa spongiosa* are seen in the lower part of the *nares*;—and the *vomer* helps to separate these two cavities.

The

* Σιαγων, γένος, mandibula.

(a) Lib. 8. cap. 1.

The bones of the *upper jaw* are joined to the bones of the ſcull by the *ſchindyleſis* and ſutures already deſcribed as common to the *cranium* and *face*, and they are connected to each other by *gomphoſis* and fifteen ſutures.

The *gomphoſis* only is where the teeth are fixed in their ſockets, and the *ſchindyleſis* is only where the edges of the *vomer* are joined to other bones.

The ſutures are generally diſtinguiſhed by numbers, which have been differently applied; and therefore I join thoſe (*a*) who prefer the giving names to each, which may be eaſily contrived from their ſituation, or from the bones which they connect.

The firſt is the *anterior naſal* *, which is ſtreight, and placed longitudinally in the middle fore-part of the noſe.

The ſecond and third are the *lateral naſal*†, which are at each ſide of the noſe, and almoſt parallel to the firſt ſuture.

Each of the two *lacrymal* is almoſt ſemicircular, and is placed round the *lacrymal* groove.

The ſixth and ſeventh are the *internal orbitar*: each of which is extended obliquely from the middle of the lower ſide of an orbit to the edge of its baſe.

The two *external orbitars* are continued, each from the end of the internal orbitar, to the under and fore-part of the cheek.

The

(*a*) Vander Linden. Medicin. phyſiolog. cap. 13. art. 2. § 10.—Rolfinc. Anat. lib. 2. cap. 25.—Schenk. Schol. part. § ult. par. 2. cap. 5.

* Naſalis recta.

† Naſalis obliquæ.

The tenth is the *myſtachial*, which reaches only from the lower part of the *ſeptum narium* to between the two middle *dentes inciſores*.

The *longitudinal palate* * future ſtretches from the middle of the foremoſt teeth through the middle of all the palate.

The *tranſverſe palate* one † runs acroſs the palate, nearer the back than the fore-part of it.

Each of the two *palato maxillary* is at the back part of the ſide of each noſtril.

The fifteenth is the *ſpinous*, which is in the middle of the lower part of the noſtrils. This may perhaps be rather thought a double *ſchindyleſis*.

The connection of the *oſſa ſpongioſa* to the ſide of each noſtril, is ſo much by a membrane in young ſubjects, by a ſort of hook, and afterwards by concretion or union of ſubſtance in adults, that I did not know well how to rank it: But if any chuſes to call it a future, the addition of two *tranſverſe naſal* futures may be made to thoſe above named.

Theſe futures of the face (formerly called *harmoniæ*) have not ſuch conſpicuous indentations as thoſe of the ſcull have; the bones here not having ſubſtance enough for forming large indentations, and there being leſs neceſſity for ſecurity againſt external injuries, or any internal protruding force, than in the *cranium*.——Theſe futures often diſappear in old people, by the bones running into each other; which can do little prejudice, becauſe the principal

* Laquearis, palataria recta.
† Arcuata, palatina poſtica.

cipal use of the bones being so numerous here, is to allow them to be extended into a proper form.

It is evident, from the manner of the conjunction of these bones, that they can have no motion, except in common with the *cranium*.

The purposes which this pile of bones serves, will be shewn in the description which I am to give of each of them.

OSSA NASI, so named from their situation at the root of the nose, are each of an irregular oblong square figure, being broadest at their lower end, narrowest a little higher than their middle, and becoming somewhat larger at the top, where they are ragged and thickest, and have a curvature forwards, that their connection with the *frontal* bone might be stronger.——These bones are convex externally, and thereby better resist any violence from without; and they are concave internally, for enlarging the cavity of the nose.

The lower edge of these bones is unequal, and is stretched outwards and backwards, to join the cartilages of the nostrils.—Their anterior side is thick, especially above, and unequal, that their conjunction to each other might be stronger; and a small rising may be remarked on their inner edge, where they are sustained by the *septum narium* ——Their posterior side, at its upper half, has externally a depression, where it is overlopped some way by the *maxillary* bones, while its lower half covers these bones: By which contrivance, they do not yield easily to pressure applied to their fore-part or sides.

A

A small hole is frequently to be observed on their external surface, into which two, three, or four holes, which appear internally, terminate for the transmission of small veins; sometimes the holes go no further than the *cancelli* of the bones.

The *nasal bones* are firm and solid, with very few *cells* or *cancelli* in them; the thin substance of which they consist not requiring much marrow.

They are joined above to the *frontal* bone, by the middle of the *transverse* suture;—— behind, to the *maxillary* bones, by the *lateral nasal* sutures;——Below, to the cartilages of the nose;——Before, to one another, by the *anterior nasal* suture;——internally, to the *septum narium*.

These bones serve to cover and defend the root of the nose.

In an infant the *nasal bones* are proportionally shorter, and less thick at their upper part, than in an adult, but are otherwise compleat.

OSSA UNGUIS, or *LACRIMALIA*, are so named, because their figure and magnitude are something near to those of a nail of one's finger, and because the tears pass upon them into the nose.

Their external surface is composed of two smooth concavities and a middle ridge.——— The depression behind forms a small share of the orbit for the eye-ball to move on, and the one before is a deep perpendicular canal, or *fossa*, larger above than below, containing part of the lacrymal *sac* and *duct*. This is the part that ought to be pierced in the great opera-

tion for the *fistula lacrymalis*.——This *fossa* of the bone is cribriform, or has a great number of small holes through it, that the filaments from the membrane which lines it, insinuating themselves into these holes, might prevent a separation of the membrane, and secure the bone in its natural situation.——The ridge between these two cavities of the *os unguis*, is the proper boundary of the orbit at its internal *canthus*; and beyond which surgeons should not proceed backwards in performing operations here.—The internal or posterior surface of this bone consists of a furrow in the middle of two convexities.

The substance of the *os unguis* is as thin as paper, and very brittle; which is the reason that those bones are often wanting in skeletons, and need little force to pierce them in living subjects.

Each of these bones is joined, above, to the *frontal* bone, by part of the *transverse* suture; ——behind, to the *os planum* of the *ethmoid* bone, by the same suture;—before, and below, to the *maxillary* bone, by the *lacrymal* suture. —internally, the *ossa unguis* cover some of the *sinus ethmoidales*; nay, are really continuous with the bony *lamellæ* which make up the sides of these cells; so that they are as much part of the *ethmoid* bone as the *ossa plana*.

These unguiform bones compose the anterior internal parts of the orbits, lodge a share of the lacrymal sac and duct, and cover the *ethmoid* cells.——Their situation and tender substance make a rash operator in danger of destroying a considerable share of the organ of smelling,

ſmelling, when he is performing the operation of the *fiſtula lacrymalis*; but when theſe bones are hurt, they caſt off without much difficulty, and conſequently the wound is ſoon cured, unleſs the patient labours under a general *cacoethes*, or there is a prediſpoſition in the bones to *caries*; in which caſe, a large train of bad ſymptoms follow, or, at beſt, the cure proves tedious.

Theſe bones are fully formed in a new born child.

OSSA MALARUM * was the name given by *Celſus*, as was already remarked, to all the upper jaw; but is now appropriated to the prominent ſquare bones which form the cheek on each ſide.——Before, their ſurface is convex and ſmooth; backward, it is unequal and concave, for lodging part of the *crotaphyte* muſcles.

The four angles of each of theſe bones have been reckoned proceſſes by ſome——The one at the external *canthus* of the orbit, called the *ſuperior orbitar* proceſs, is the longeſt and thickeſt.——The ſecond terminates near the middle of the lower edge of the orbit in a ſharp point, and is named the *inferior orbitar* proceſs.——The third, placed near the lower part of the cheek, and thence called *maxillary*, is the ſhorteſt, and neareſt to a right angle.——The fourth which is called *zygomatic*, becauſe it is extended backwards to the *zygoma* of the temporal bone, ends in a point, and has one ſide ſtreight, and the other ſlopping.—Between the

* Jugalia vel zygomatica, hypopia, ſubocularia.

two orbitar angles there is a concave arch, which makes about a third of the external circumference of the orbit, from which a fifth proceſs is extended backwards within the orbit, to form near one third of that cavity; and hence it may be called the *internal orbitar* proceſs.—From the lower edge of each of the *oſſa malarum*, which is between the maxillary and zygomatic proceſſes, the *maſſeter* muſcle takes its origin; and from the exterior part of the *zygomatic* proceſs, the *muſculus diſtortor oris* riſes; in both which places the ſurface of the bone is rough.

On the external ſurface of each cheek bone, one or more ſmall holes are commonly found, for the tranſmiſſion of ſmall nerves or blood-veſſels from, and ſometimes into the orbit.—On the internal ſurface are the holes for the paſſage of the nutritious veſſels of theſe bones.———A notch on the outſide of the *internal orbitar* proceſs of each of theſe bones aſſiſts to form the great ſlit common to this bone and to the ſphenoid, maxillary, and palate bones.

The ſubſtance of theſe bones is, in proportion to their bulk, thick, hard, and ſolid, with ſome *cancelli*.

Each of the *oſſa malarum* is joined, by its ſuperior and internal orbitar proceſſes, to the *os frontis*, and to the orbitar proceſs of the *ſphenoid* bone, by the *tranſverſe* ſuture.———By the edge between the internal and inferior orbitar proceſſes, to the *maxillary bone*, by the *internal orbitar* ſuture.—By the ſide between the maxillary and inferior orbitar proceſs, again to the maxillary bone, by the *external orbitar* ſuture.

future.——By the zygomatic process, to the *os temporum*, by the *zygomatic* future.

The cheek bones are entire, and fully ossified in all their parts in infants.

OSSA MAXILLARIA SUPERIORA, are the largest bones, and constitute the far greater part of the upper jaw, which has appropriated the name of *maxillaria* to them. The figure of one of them, or of the two when joined, is so irregular, that words can scarce give an idea of it.

The processes of each *os maxillare* may be reckoned seven.—The *first* is the long nasal one at its upper and fore-part, which is broad below, and turns smaller, as it rises upwards, to make the side of the nose.——At the root of this, a transverse ridge may be observed within the nostrils, which supports the fore-part of the upper edge of the *os spongiosum inferius*.—The *second* is produced backwards and outwards, from the root of the nasal process, to form the lower side of the orbit; and therefore may be called *orbitar*.—The edge of this orbitar process, and the ridge of the nasal one, which is continued from it, make a considerable portion of the external circumference of the orbit.—From the proper orbitar process, a very rough triangular surface is extended downwards and outwards, to be connected to the cheek-bone; and therefore may be called the *malar* process, from the lowest protuberant part of which some share of the masseter muscle takes its rise.——Behind the orbitar process, a large tuberosity or bulge of the bone appears, which is esteemed the *fourth* process.——On the internal

part

part of this we often meet with a ridge, almoſt of the ſame height with that in the naſal proceſs, which runs tranſverſely, and is covered by a ſimilar ridge of the *palate* bone, on which the back part of the upper edge of the *os ſpongioſum inferius* reſts.——The convex back-part of this tuberoſity is rough for the origin of part of the external *pterygoid* muſcle (*a*), and more internally is ſcabrous, where the palate and ſphenoid bones are joined to it.—That ſpongy protuberance * at the lower circumference of this bone, where the ſockets for the teeth are formed, is reckoned the *fifth*.—The *ſixth* is the horizontal plate, which forms the greater part of the baſe of the noſtrils, and roof of the mouth; its upper ſurface, which belongs to the noſtrils, is very ſmooth, but the other below is arched and rough, for the ſtronger adheſion of the membrane of the mouth, which is ſtretched upon it, and in chewing, ſpeaking, *&c.* might otherwiſe be liable to be ſeparated.—The *ſeventh* riſes like a ſpine from the inner edge of the laſt, and forms a ſmall part of the partition of the noſtrils.

The depreſſions in each *maxillary* bone are, 1. A ſinuoſity behind the orbitar proceſs, made by the *temporal* muſcle. 2. A pit immediately before the ſame proceſs, where the origin of the *muſculus elevator labiorum communis*, and *elevator labii ſuperioris*, with a branch of the fifth pair of nerves, are lodged ſecurely. 3. The hollow arch of the palate. 4. The ſemicircular great notch, or entry to the lower part of the

(*a*) Albin. de oſſib. § 79.

* Φαρυγια.

the noſtrils, betwixt the root of the naſal proceſs and ſpine of the palate-plate.—Below this, the fore part of the bone is flatted, or ſometimes hollowed by the *muſculus depreſſor labii ſuperioris*. 5. Sockets for the teeth† : The number of theſe ſockets is uncertain; for the ſame number of teeth is not in all people, and the four backmoſt teeth of each ſide of each jaw vary greatly in their number of roots; and when the teeth of a living perſon fall out, or are taken away, the ſockets fill up with an oſſeous net-work, which becomes ſolid afterwards. 6. The *lacrymal foſſa* in the *naſal proceſs*, which aſſiſts the *os unguis* to form a paſſage for the *lacrymal duct*. This part of the bone forming this *foſſa* is ſo firm and ſtrong that a ſurgeon ſcarce can perforate it with the ordinary inſtruments for the *fiſtula lacrymalis*, and therefore ought to avoid it in doing this operation—Immediately on the outſide of this, there is a ſmall depreſſion, from which the inferior or leſſer oblique muſcle of the eye has its origin (*a*). 7. The canal on the upper part of the great tuberoſity within the orbit, which is almoſt a compleat hole; in this a branch of the ſuperior maxillary nerve paſſes.—Beſides theſe, the ſuperior ſurface of the great bulge is concave, to receive the under part of the eye —Immediately above the tranſverſe ridge in the naſal proceſs, a ſmall hollow is formed by the *os ſpongioſum*.——In ſome ſubjects, the naſal proceſs has a ſmall round pit above the lacrymal duct, where

† Βόθρια, ὀλμίσκοι, alveoli, foſſulæ, mortariola, fræna, locelli, cavæ, pralſepiola, loculamenta.

(*a*) Winſlow, Expoſition anatomique des os ſecs, § 276.

where the little tendon or ligament of the orbicular muscle of the eye-lids is inserted. It is this tendon, and not the tendon of the larger oblique muscle of the eye, which there is some hazard of cutting in the operation of the *fistula lacrymalis*.

The holes of this bone are two proper and two common, which are always to be found, besides several others, whose magnitude, number, *&c.* are uncertain.——The first of the proper is the *external orbitar*, immediately below the orbit, by which the infra-orbitar branch of the second branch of the fifth pair of nerves, and a small artery, come out, after having passed in the canal, at the bottom of the orbit, described *numb.* 7. of the depressions.—This hole is often double, and that when the nerve has happened to split before it has escaped from the bone —The second is the *foramen incisivum*, just behind the fore-teeth which, at its under part, is one irregular hole common to both the *maxillary* bones when they are joined; but, as it ascends, soon divides into two, three, or sometimes more holes: some of which open into each nostril. Thro' them small arteries and veins, and a twig of the second branch of the fifth pair of nerves pass, and make a communication between, or join the lining coats of the nose and mouth.—In some subjects, *Steno's* duct may be traced some way on the side of these passages next to the nose, and small orifices may be observed opening into the mouth.

The first common hole is that which appears at the inner side of the back part of the *tube-*

rosity

rosity and of the sockets of the teeth, and is formed by a *fossa* in this bone, and a corresponding one in the *os palati*: through it a nerve, which is a branch of the second branch of the fifth pair, runs to the palate.——The other common hole is the great slit in the outside of the orbit described already, as the second common hole of the sphenoid bone.

On the nasal process often holes may be observed for the passage of vessels to the substance of the bones; and, at the back-part of each tuberosity, several *foramina* are placed, for the transmission of nerves to the cavity within: but these are uncertain

All the body of the *maxillary* bone is hollow and leaves a large *sinus* akin to the *frontal* and *sphenoid*, which is commonly, but unjustly, called *antrum Highmorianum* *. When the *os maxillare* is single or separated from all the other bones of a skeleton, its *antrum* appears to have a large aperture into the nostrils; but, in a recent subject, it is so covered at its back-part, by the *palate* bone; in the middle, by the *os spongiosum inferius*; before, by a strong membrane, that one or sometimes two holes, scarce larger than a crow-quill, are only left at the upper part; which, after a short winding progress, open into the nostrils between the two *ossa spongiosa*.—At the bottom of this cavity, we may often observe some protuberances, in which the small points of the roots of the teeth are contained, (*a*).——This cavern and the sockets of the teeth are often divided by the

* Genæ.

(*a*) Highmore, Disquis. anat. lib. 3. part. 2. cap. 1.

the interpoſition only of a very thin bony plate, which is liable to be eroded by acrid matter collected in the *antrum*, or to be broke in drawing a tooth (*a*). The ſymptoms of a collection of a matter here naturally lead us to the practice of pulling out the teeth, and piercing through this plate into the *antrum*, to procure an evacuation of the collected matter; by which conſiderable ſervice is frequently done (*b*).

The *maxillary ſinuſes* have the ſame uſes as the *frontal* and *ſphenoidal*; and the ſituation of the *ſinuſes* is ſuch, that the liquor drilling from them, from the cells of the ethmoid and palate bones, and from the lacrymal ducts, may always moiſten all the parts of the membrane of the *nares* in the different ſituations which the head is in.

Though the membranes which line the *frontal*, *ſphencidal*, and *maxillary ſinuſes*, are continuations of the one which covers the bones within the noſe; yet they are much thinner than it is, and have ſo much ſmaller veſſels, that the injection which makes the membrane of the noſe red all over, fills only ſome few veſſels of the *maxillary ſinuſes*, and ſcarce is obſerved in the *frontal* and *ſphencidal*. Are not the larger veſſels intended for a more plentiful ſecretion of a viſcid liquor to defend the membrane from the effects of the *perflatus*, which is conſtantly through the noſe? Are not the membranes which have the ſmalleſt veſſels, *cæteris paribus*, the moſt ſenſible? Are not

(*a*) Highmore, ibid.
(*b*) Cowper in Drake's anthropol. book 3. chap. 10. — Medical Eſſays and obſerv. vol. 5. art. 30.

not many phænomena of ſmelling, inflammations of theſe parts, *megrim*, *polypi*, *&c.* depending on this ſtructure of theſe membranes?

The ſubſtance of the *oſſa maxillaria* is compact and firm, except at the inferior proceſſes, in which the teeth are lodged, where it is very ſpongy.

The *maxillary* bones are joined above by the upper ends of their naſal proceſſes to the *os frontis*, by the *tranſverſe* ſuture;—at the ſides of theſe proceſſes, to the *oſſa unguis*, by the *lacrymal* ſutures;——to the *naſal* bones, by the *lateral naſal* ſutures;—by their orbitar proceſſes, to the *cheek* bones, by the *external orbitar* ſutures;—by the internal ſides of the internal orbitar proceſſes, to the *oſſa plana*, by part of the *ethmoidal* ſuture;———by the back-part of the tuberoſities, to the *palate* bones, by the *futuræ palato-maxillares*;——by the poſterior edges of their palatine *lamellæ*, to the *oſſa palati*, by the *tranſverſe* palate ſuture;——by their naſal *ſpines* to the *vomer*, by the *ſpinous* ſuture;——by their ſockets, to the teeth by *gomphoſis*;——by the internal edge of the palate-plate, to one another, by the *longitudinal* palate ſuture; on the upper and fore-part of which a furrow is left for receiving the cartilage which forms the partition of the noſtrils;——between the fore-part of the noſtrils and mouth, to each other, by the *myſtachial* ſuture;——ſometimes they are connected to the *oſſa ſpongioſa inferiora*, by a plain concretion or union of ſubſtance.

Theſe bones form the greater part of the noſe and of the roof of the mouth, and a

conſiderable ſhare of the orbit. They contain ſixteen teeth, give riſe to muſcles, tranſmiſſion to nerves, *&c.* as mentioned in the deſcription of their ſeveral parts.

In each of the *maxillary* bones of a new-born child, the external orbitar proceſs is hollow with remarkable holes in it;——there are five ſockets for the teeth, of which the two poſterior are very large, and, when divided by a ſecond croſs partition, make the number of ſockets ſix (*a*).——The palate-plate is cribriform about the middle.——The great tuberoſity is not formed;——inſtead of the *antrum*, there is only an oblong depreſſion at the ſide of the noſtrils.

OSSA PALATI are commonly deſcribed as two ſmall ſquare bones, at the back-part of the palate or roof of the mouth, though they are of much greater extent, being continued up the back part of the noſtrils to the orbit (*b*). Each palate-bone may therefore be divided into four parts, the palate ſquare bone, the pterygoid proceſs, naſal *lamella*, and orbitar proceſs.

The ſquare bone is unequally concave, for enlarging both the mouth and cavity of the noſe. The upper part of its internal edge riſes in a ſpine, after the ſame manner as the palate-plate of the *maxillary* bone does, to be joined with the *vomer*.——Its anterior edge is unequally ragged, for its firmer connection with

(*a*) Albin. Oſteogen. tab. 5. fig. 45.——Ungebav. de dentit. ſecund. jun. § 1.

(*b*) Euſtach. tab. 47. fig. 1. 3. 6. 7. 8.——Vidus Vidius, de Anat. lib. 2. cap. 2. explicat. tab. 6. fig. 19.—Winſlow Memoires de l'acad. des ſciences, 1720.

with the palate-process of the *os maxillare*.—The internal edge is thicker than the rest, and of an equal surface, for its conjunction with its fellow of the other side.——Behind, this bone is somewhat in form of a crescent, and thick, for the firm connection of the *velum pendulum palati*; the internal point being produced backwards, to afford origin to the *palato-staphylinus* or *azygos* muscle.—This square bone is well distinguished from the *pterygoid* process by a perpendicular *fossa*, which, applied to such another in the *maxillary* bone, forms a passage for the palatine branch of the fifth pair of nerves; and by another small hole behind this, through which a twig of the same nerve passes.

The *pterygoid* process is somewhat triangular, having a broad base, and ending smaller above. The back-part of this process has three *fossæ* formed in it; the two lateral receive the ends of the two plates of the sphenoid bone, that are commonly compared to a bat's wing; the middle *fossa* makes up a part of what is commonly called the *fossa pterygoidea*; the fore side of this palatine pterygoid process is an irregular concave, where it receives the back part of the great *tuberosity* of the *maxillary* bone.——Frequently several small holes may be observed in this triangular process, particularly one near the middle of its base, which a little above communicates with the common and proper holes of this bone already taken notice of.

The *nasal lamella* of this bone is extremely thin and brittle, and rises upwards from the upper side of the external edge of the square-bone, and from the narrow extremity of the

pterygoid proceſs; where it is ſo weak, and, at the ſame time, ſo firmly fixed to the *maxillary* bone, as to be very liable to be broken in ſeparating the bones.——From the part where the plate riſes, it runs up broad on the inſide of the *tuberoſity* of the *maxillary* bone, to form a conſiderable ſhare of the ſides of the *maxillary ſinus*, and to cloſe up the ſpace between the *ſphenoid* and the great bulge of the maxillary bone, where there would otherwiſe be a large ſlit opening into the noſtrils (*a*). From the middle internal ſide of this thin plate, a croſs-ridge placed on ſuch another of the maxillary bone is extended; on it, the back-part of the *os ſpongioſum inferius* reſts.—Along the outſide of this plate, the perpendicular *foſſa* made by the palate nerve is obſerveable.

At the upper part of this naſal plate, the palate bone divides into two proceſſes, which I already named *orbitar*;—between which and the body of the *ſphenoid* bone, that hole is formed, which I mentioned as the laſt of the holes common to the *ſphenoid* bone.——Sometimes this hole is wholly formed in the *os palati*, by a croſs plate going from the one orbitar proceſs to the other. A nerve, artery, and vein belonging to the noſtrils paſs here.—The anterior of the two orbitar proceſſes is the largeſt, and has its fore-part contiguous to the back-part of the *maxillary ſinus*, and its upper ſurface appears in the bottom of the orbit, behind the back-part of the *os maxillare* and *planum*.

(*a*) Albin. de oſſib. § 88.

num.—It has cells behind reſembling thoſe of the *ethmoid* bone, to which it is contiguous; it is placed on the aperture of the *ſinus ſphenoidalis*, ſo as to leave only a round hole at its upper fore-part.—The other part of the orbitar proceſs is extended along the internal ſide of the upper back part of the maxillary *tuberoſity*, to the baſe of the *ſphenoid* bone, between the root of the *proceſſus azygos* and the pterygoid proceſs.

The palate ſquare part of this palate-bone, and its pterygoid proceſs, are firm and ſtrong, with ſome *cancelli*; but the naſal plate and orbitar proceſſes are very thin and brittle.

The palate-bones are joined to the *maxillary*, by the fore-edge of the palate ſquare bone, by the *tranſverſe palate* future:—By their thin naſal plates, and part of their orbitar proceſſes, to the ſame bones, by the *palato-maxillares* futures:—By their *pterygoid* proceſſes, and back-part of the *naſal plates*, to the *alæ veſpertilionum*, by the *ſphenoid* future:——By the tranſverſe ridges of the naſal plates, to the *oſſa ſpongioſa inferiora*, by contact; hence frequently there is an intimate union of the ſubſtance of theſe bones in old ſculls:——By the orbitar proceſſes, to the *oſſa plana* and *cellulæ ethmoideæ*, by the *ethmoid* future:——To the body of the *ſphenoid* bone, by the *ſphenoid* future:—By the internal edge of the ſquare bones, to each other, by the *longitudinal* palate future; and by their naſal ſpines, to the *vomer*, by the *ſpinous* future.

The palate-bones form part of the palate, noſtrils, orbits, and *foſſæ pterygoideæ*, and

they cover part of the *sinus maxillares*, *sphenoidales*, and *ethmoidei*.

These bones are very complete in a new-born infant, the nasal plates being then thicker and stronger than in adults; but the orbitar processes have not the cells which appear in the bones of adults.

When we are acquainted with the history of these bones, the reason is evident, why the eyes are so much affected in ulcers of the palate, as to be often attended with blindness, which frequently happens in an ill-managed *lues venerea*; or why, on the other hand, the palate suffers from an *ægylops (a)*.

OSSA TURBINATA, or *spongiosa inferiora*, resemble the superior *ossa spongiosa* in shape and substance, but have their anterior and upper edges contiguous to the transverse ridges of the nasal processes of the *maxillary* and *palate bones*.——From their upper streight edge, two small processes stand out: the posterior, which is the broadest, descends to cover some of the *antrum Highmorianum*; the anterior rises up to join the *os unguis*, and to make part of the *lacrymal duct*.

Below the spongy bones already mentioned, there are sometimes two others, one in each nostril, which seem to be a production of the sides of the maxillary *sinus* turned downwards (*b*). When this third sort of spongy bones is found, the middle one of the three in each nostril is the largest, and the lowest is the smallest.

(*a*) Hoffman. in Ephemerid. German. cent. 1. and 2. observ. 135.

(*b*) Cowper in Drake's Anthropolog. book 3. chap. 10.

eſt——Beſides all theſe, there are often ſeveral other ſmall bones ſtanding out into the noſtrils, that, from their ſhape, might alſo deſerve the name of *turbinata*, but are uncertain in their bulk, ſituation, and number (*a*).

The names of theſe bones ſufficiently declare their ſpongy ſubſtance, which has no firm external plate covering it.

They are joined to the *oſſa maxillaria palati*, and *unguis* in old ſubjects, by a firm union of ſubſtance: and as this happens alſo frequently in people of no great age, ſome (*b*) are of opinion, that they ſhould be eſteemed part of the palate bones; others (*c*) think, that ſince their upper edge is continued by a plate to a part of the *os ethmoides*, they ought to be eſteemed to be a part of this bone.

Their uſe is, to ſtraiten the noſtrils, to afford a large ſurface for extending the organ of ſmelling, to cover part of the *antra maxillaria*, and to aſſiſt in forming the under part of the lacrymal ducts, the orifices of which into the noſe are concealed by theſe bones.

The *oſſa turbinata* are nearly complete in a new born infant.

VOMER, or bone reſembling a ploughſhare, is the thirteenth of the upper jaw, without a fellow, forming the lower and backparts of the partition of the noſe (*d*).

The

(*a*) Santorin. Obſervat. anatomic. cap. 5. § 9.
(*b*) Id. ibid. cap. 5. § 7.
(*c*) Hunauld. in Memoires de l'acad. des ſciences, 1730.
(*d*) Columb. de re anat. lib. 1. cap. 8.—Fallop. Obſervat. anatom.

The figure of this bone is an irregular rhomboid.—Its sides are flat and smooth.—Its posterior edge appears in an oblique direction at the back part of the nostrils.—The upper one is firmly united to the base of the *sphenoid* bone, and to the nasal plate of the *ethmoid*; and, when it can be got separated, is hollow, for receiving the *processus azygos* of the *sphenoid*.—The anterior edge has a long furrow in it, where the middle cartilage of the nose enters.—The lower edge is firmly united to the nasal spines of the maxillary and palate bones.—These edges of this bone are much thicker than its middle, which is as thin as the finest paper; by which, and the firm union or connection this bone has above and below, it can very seldom be separated entire in adults: But, in a child, it is much more easily separated entire, and its structure is more distinctly seen: wherefore I shall examine all its parts of such a subject.

Its situation is not always perpendicular, but often inclined and bended to one side, as well as the nasal plate of the *ethmoid* bone.

The *vomer* is convex at its upper part, and then is streight, as it is extended downwards and forwards where it is composed of two plates; the edges of which have a great number of small processes, disposed somewhat like the teeth of a saw, but more irregularly, and several of them are reflected back. Between these plates a deep *fossa* is left, which, so far as the top of the curvature, is wide, and has strong sides, for receiving the *processus azygos* of the *sphenoid* bone. Beyond the arch forwards,

wards, the *foſſa* is narrower and ſhallower gradually to the point of the bone, receiving for ſome way the naſal *lamella ethmoidea;* which, after the oſſification is complete, is ſo cloſely united to the *vomer* by the little proceſſes piercing into its ſubſtance, as to prevent any ſeparation; on which account it has been eſteemed by ſome (*a*) a part of the ethmoid bone. The middle cartilage of the noſe fills up what remains of the *foſſa* at its fore-part.——The poſterior edge of the *vomer*, which appears above the back-part of the palate bones, is broader above; but as it deſcends forwards, becomes thinner, though it is ſtill ſolid and firm. —The lower edge of this bone, which reſts on the naſal ſpine of the *palate* and *maxillary* bones, has a little furrow on each ſide of a ſmall middle ridge, anſwering to the ſpines of the bones of different ſides, and the interſtice between them. This edge, and the upper one meet in the pointed fore-end of this bone.

The body of the *vomer* has a ſmooth ſurface, and ſolid, but thin ſubſtance; and towards its ſides, where it is thickeſt, ſome *cancelli* may be obſerved, when the bone is broken.

It is joined above to the *ſphenoid* and *ethmoid* bones, and to the middle cartilage of the noſe by *ſchindyleſis*;—below, to the maxillary and palate bones, by the *ſpinous* ſuture.

The *vomer* divides the noſtrils, enlarges the organ of ſmelling, by allowing place for expanding the membrane of the noſe on its ſides, and ſuſtains the palate-plates of the *maxillary*

a) Lieutaud. Eſſais anatomiques 1. ſect. l'os ethmoide.

xillary and *palate* bones, which otherwise might be in hazard of being preſſed into the noſtrils; while the *vomer* is ſecured from ſhuffling to one ſide or other by the double *ſchindyleſis*, by which it is joined to the bones above and below.

Theſe then are all the bones which compoſe the upper jaw, except the teeth, which are ſo much a-kin to thoſe of the lower jaw, that I chuſe to make one deſcription ſerve for both, in which the differences obſervable in them ſhall be remarked, after the ſecond part of the face, the lower jaw, is examined; becauſe the ſtructure of the teeth cannot be well underſtood, untill the caſe in which they are ſet is explained.

MAXILLA INFERIOR *, the lower jaw conſiſts only of one moveable bone, and ſixteen teeth incaſed into it.

This bone, which is ſomewhat of the figure of the *Greek* letter *υ*, is ſituated at the lower part of the face, ſo as its convex middle part is forwards, and its legs are ſtretched back. It is commonly divided into the chin, ſides, and proceſſes.—The *chin* is the middle fore-part, the extent of which to each ſide is marked on the external ſurface by the holes obſervable there, and internally by the beginning of an oblique ridge.—Beyond theſe the *ſides* appear, and are continued till the bone, by bending upwards, begins to form the proceſſes.

On the fore-part of the *chin*, a tranſverſe ridge appears in the middle, on each ſide of which

* Τὸνος, σιαγὼν, mandibula, facies.

which the *muſculi quadrati*, or *depreſſores labii inferioris*, and the *levatores labii inferioris*, depreſs the bone: And below theſe prints, a ſmall riſing may be obſerved, where the *depreſſores* commence.——On the back part of the chin, ſometimes three, always two, ſmall protuberances appear in the middle. To the uppermoſt, when it is ſeen, the *frænum* of the tongue is connected. From the middle one, the *muſculi genioglaſſi* riſe; and from the loweſt, the *geniohycidei* have their origin. Below the laſt, we ſee two rough ſinuoſities formed by the *digaſtric* muſcles.

At the lower and fore-part of the external ſurface of each ſide of the lower jaw, a ſmall eminence may be obſerved, where the *depreſſor labiorum communis* riſes. Near the upper edge of the ſide a ridge runs length ways, to which the under part of the *muſculus buccinator* is connected.——Internally, towards the upper edge of each ſide, another ridge appears, from which the *mylohyoidei* have their origin, and to which the internal membrane of the gums adheres.

In the upper edge of both chin and ſides are a great many deep pits or ſockets, for receiving the roots of the teeth. The number and magnitude of theſe ſockets are various, becauſe of the different number, as well of the teeth themſelves, as of their roots, in different people. Theſe ſockets in this lower jaw, as well as in the upper one, are leſs deep as old age comes on; when freed from the teeth by any means, they are ſome time after filled up with an oſſeous net-work, which at laſt becomes entirely

entirely solid, and as smooth as any other part of the bone; so that in a great many old jaws one cannot observe a vestige of the sockets: But then the jaw becomes less, and much narrower (*a*).—Hence we may know why the chin and nose of edentulous people are much nearer than before the teeth were lost; while their lips either fall in towards the mouth, or stand prominent forwards.——When new teeth are protruded, new sockets are formed (*b*).—The lower edge of the chin and sides is smooth and equal, and is commonly called the *base* of the lower jaw.—The ends of the base, where the jaw turns upwards, are called its *angles*; the external surface of each of which has several inequalities upon it, where the *masseter* muscle is inserted; as the internal surface also has, where the *pterygoideus internus* is inserted, and a ligament extended from the *styloid* process of the temporal bone is fixed.

The processes are two on each side.——The anterior sharp thin *coronoid* ones have the *crotaphite* muscles inserted into them.——The posterior processes or *condyles* * terminate in an oblong smooth head, supported by a *cervix*. The heads whose greatest length is transverse, and whose convexity is turned forwards, are tipped with a cartilage, as the articulated parts of all other moved bones are.—The fore part of the root and neck of these *condyloid* processes are a little hollow and rough, where the external *pterygoid* muscles are inserted.

The

(*a*) Vesal. Anat. lib. 1. cap. 10
(*b*) Fallop. Observ. anat.
* Articulatorii.

The holes of the lower jaw are two on each side; one at the root of the proceſſes internally, where a large branch of the third branch of the fifth pair of nerves enters with an artery, and a vein returns. A ſmall ſharp proceſs frequently jutts out backwards from the edge at the fore-part of this hole, to which a ligament extended from the temporal bone is fixed (*a*), which ſaves the nerve and veſſels from being too much preſſed by the *pterygoid* muſcles.——From the lower ſide of this hole, either a ſmall ſuperficial canal or a furrow deſcends, where a branch of the nerve is lodged, in its way to the *mylo-thyoideus* muſcle and ſublingual gland (*b*).—The other hole is external, at the confines of the chin, where branches of the nerve and veſſels come out.——The canal betwixt theſe two holes is formed in the middle of the ſubſtance of the bone, and is pierced by a great number of ſmall holes by which the nerves and blood veſſels of the *cancelli* and teeth paſs. This canal is continued a little further than the external hole at the chin.—On account of the veſſels and nerves in the lower jaw, fractures of it may be attended with dangerous ſymptoms.

The ſurface of the lower jaw is hard and firm, except at the ſpongy ſockets, where however it is ſtronger than the upper jaw.——Its internal ſubſtance is cellular, without any ſolid partition between the *cancelli* in its middle.———At the baſe, eſpecially of the chin,

N where

(*a*) Weitbrecht. Syndeſmolog. fig. 32. 1.
(*b*) Palfyn. Anat. chirur. traite 5. chap. 6.

where this bone is moſt expoſed to injuries, the ſolid ſides of it are thick, compact, and hard.

The lower jaw generally receives the roots of ſixteen teeth into its ſockets, by *gomphoſis*; and its *condyloid* proceſſes, covered with cartilage, are articulated with the *temporal* bones, in a manner that is not commonly deſcribed right: For, as was already mentioned in the deſcription of the temporal bones, not only the fore part of the cavity between the *zygomatic auditory*, and *vaginal* proceſſes, but alſo the adjoining tubercle at the root of the *zygomatic* proceſs of each *os temporum* is covered with a ſmooth cartilage, for this articulation.——— Here alſo an intermediate moveable cartilage is placed, which being thin in the middle, and thick at the edges, is concave on both ſides; and is connected ſo firmly by ligaments to each *condyle*, as to follow the motions of the *condyle*; and ſo looſely to the *temporal* bone, as readily to change its ſituation from the cavity to the tubercle, and to return again; while the common ligament of the articulation affords ſpace enough for ſuch a change of place backwards and forewards; but like other ligaments of the joints by *ginglimus*, is ſtrong and ſhort at the ſides, to confine the lateral motions.

When therefore the teeth of both jaws coincide, the *condyles* are lodged ſecurely in the temporal cavities, but their motions to either ſide muſt be confined both by the firmneſs of the ligaments, and the riſing brims which are on each ſide of the cavities.———

When

When the jaw is brought directly forewards, the condyle and intermediate cartilages descend and advance forewards upon the tubercles.——In this situation the lateral motions are a little more free than in the former one, from the want of rising brims to stop the condyles.——When the fore-teeth of the lower jaw are moved forewards, and to a side, the condyle of the opposite side is either advanced from the cavity to the tubercle, while the condyle of the same side remains in the cavity; or if both condyles are on the tubercles, when the jaw is moved obliquely to a side, the condyle of the side to which the motion is made slides back from the tubercle to the cavity.—— When the mouth is opened by the descent of the lower jaw, the fore part of it, where the *depressing* muscles are fixed, is drawn backwards, as well as downwards, while resistance is made to the angles moving backwards by the *masseter* and *internal pterygoid* muscles, and, at the same time, the *external pterygoid* draw the condyles and their moveable cartilages forewards; and therefore, when the mouth is opened, the condyles are carried forewards upon the tubercles, and the axis of motion of the bone is a little above its angles. But in this situation there is less resistance, than in any other, to the condyles luxating forewards; a disease which seldom happens, except when people are gaping too wide; and therefore the common practice of nurses, who support the jaw of infants when they are yawning, is reasonable.—

In-

In chewing there is a succeſſion of the motions above deſcribed (*a*).

Here a general remark may be made, That where-ever moveable cartilages are found in joints, either the articulated bones are of ſuch a figure, or ſo joined and fixed by their ligaments, that little motion would be allowed without ſuch cartilages; or elſe ſome motions are neceſſary to the right uſe of the member, which the form of the articulation would not otherwiſe admit of. This will more fully appear after the other joints with ſuch cartilages are deſcribed.

In a child born to the full time, the lower jaw is compoſed of two bones, connected by a thin cartilage in the midle of the chin, which gradually oſſifies, and the two bones intimately unite.——In each of theſe bones there are five or ſix ſockets for teeth as in the upper jaw.

After I have thus deſcribed the incaſement of the teeth, the inſertion of ſo many muſcles of the tongue, and of the *os hyoides*, the connection of the membrane of the tongue to the maxillary bone, and the motions of this bone; it is eaſy to ſee, that the lower jaw muſt be a principal inſtrument in manducation, deglutition, and ſpeech.

The *TEETH* are the hard white bodies placed in the ſockets of both jaws. Their number is generally ſixteen above, and as many

(*a*) For a more full account of this articulation, vid. Edinburgh Medical eſſays and obſerv. vol. 1. art. 11. and vol. 3. art. 13.——Memoires de l'acad. des ſciences, 1744.

ny below; though some people have more, others have fewer.

The broad thick part of each tooth which appears without the socket, is the *base* or body*. ——The smaller processes sunk into the *maxillæ*, are the *roots* or *fangs*, which become gradually smaller towards the end farthest from the base, or are nearly conical, by which the surface of their sides divides the pressure made on the bases, to prevent the soft parts, which are at the small points of the sockets, to be hurt by such pressure.——At the place where the base ends, and the roots begin, there is generally a small circular depression, which some call the *neck* or *collar*.

Without the gums the teeth are covered with no membrane, and they are said to have no proper *periosteum* within the sockets; but that is supplied by the reflected membrane of the gums; which, after a good injection, may be evidently seen in a young subject, with the vessels from it penetrating into the substance of the teeth; and it may be discovered in any tooth recently pulled, by macerating it in water (*a*). The adhesion of this membrane to these roots is strengthened by the small furrows observable on them.

Each tooth is composed of its *cortex*, or *enamel*, and an internal bony substance. The *cortex* has no cavity or place for marrow; and is so solid and hard, that saws or files can with difficulty make impression on it. It is thickest upon the base, and gradually, as the

* Corona.

(*a*) Cowper. Anatom. explicat. tab. 92. fig. 7. lit. E.

roots turn ſmaller, becomes thinner, but not proportionally to the difference of the ſize of the baſe and roots.——The fibres of this enamel are all perpendicular to the internal ſubſtance, and are ſtreight on the baſe, but at the ſides are arched with a convex part towards the roots (*a*); which makes the teeth reſiſt the compreſſion of any hard body between the jaws, with leſs danger of breaking theſe fibres, than if they had been ſituated tranſverſely. The ſpongy ſockets in which the teeth are placed likewiſe ſerve better to prevent ſuch an injury, than a more ſolid baſe would have done.——Notwithſtanding the great hardneſs of this *cortex*, it is waſted by manducation. Hence the ſharp edges of ſome teeth are blunted, and made broad, while the rough ſurfaces of others are made ſmooth and flat, as people advance in life.

The bony part of the teeth has its fibres running ſtreight, according to the length of the teeth. When it is expoſed to the air, by the breaking or falling off of the hard *cortex*, it ſoon corrupts. And thence carious teeth are often all hollow within, when a very ſmall hole appears only externally.

The teeth have canals formed in their middle, wherein their nerves and blood veſſels are lodged; which they certainly need, being conſtantly waſted by the attrition they are ſubjected to in manducation, and for their further growth, not only after they firſt appear, but even in adults; as is evident when a tooth is taken

(*a*) Haver's Oſteolog. nov. diſc. 1.

taken out: For then the oppoſite one becomes longer, and thoſe on each ſide of the empty ſocket turn broader; ſo that when the jaws are brought together, it is ſcarce obſervable where the tooth is wanting (*a*).

The veſſels are eaſily traced ſo long as they are in the large canal, but can ſcarce be obſerved in their diſtribution from that to the ſubſtance of the teeth of adults. Ruyſch (*b*) however affirms, that after injection he could trace the arteries into the hardeſt part of the teeth: And Leewenhoek (*c*) ſuſpected the fibres of the *cortex* to be veſſels. In children I have frequently injected the veſſels of the teeth as far as their baſe: And in ſuch as are not intirely oſſified, one can with a lucky injection fill ſo many veſſels, as to make both the outſide and inſide of the cortical part appear perfectly red. ——This plentiful ſupply of veſſels muſt expoſe the teeth to the ſame diſorders that attack other vaſcular parts; and ſuch teeth as have the greateſt number of veſſels, muſt have the moſt numerous chances of being ſeized with theſe diſeaſes.

Every root of each tooth has ſuch a diſtinct canal, with veſſels and nerves in it. Theſe canals in the teeth with more than one root, come nearer each other, as they approach the baſe of the tooth; and at laſt are only ſeparated by very thin plates, which being generally incompleat, allow a communication of all the

(*a*) Ingraſ. de tumor. cap. 1. p. 24. 25. 26.
(*b*) Theſaur. 10. num. 27.
(*c*) Arcan. natur. continuat. epiſt. p. 3.

the canals; and frequently one common cavity only appears within the base, in which a pulpy substance composed of nerves and vessels is lodged. The condition therefore of the nerves here bears a strong analogy to that of the cutaneous nerves which serve for the sensation of touching.

The entry of the canals for these vessels is a small hole placed a little to a side of the extreme point of each root; sometimes, especially in old people, this hole is entirely closed up, and consequently the nerves and blood-vessels are destroyed (*a*).

The teeth are seen for a considerable time in form of *mucus* contained in a membrane, afterwards a thin cortical plate, and some few osseous layers appear within the membrane, with a large cavity filled with *mucus* in the middle; and gradually this exterior shell turns thicker, the cavity decreases, the quantity of *mucus* is lessened, and this induration proceeds till all the body is formed; from which the roots are afterwards produced.

In young subjects, different *stamina* or rudiments of teeth are to be observed. Those next the gums hinder ordinarily the deeper seated ones from making their way out, while these prevent the former from sending out roots, or from entering deep into the bony sockets of the jaws; by which they come to be less fixed.

Children are seldom born with teeth; but at two years of age they have twenty; and their number does not increase till they are about

(*a*) De la Hire Histoire de l'acad. des sciences, 1699.

bout seven years old, when the teeth that first made their way through the gums are thrust out by others that have been formed deeper in the jaw, and some more of the teeth begin to discover themselves farther back in the mouth. About fourteen years of age, some more of the first crop are shed, and the number is increased.——This shedding of the teeth is of good use; for if the first had remained, they would have stood at a great distance one from another; because the teeth are too hard in their outer crust, to increase so fast as the jaws do. Whereas both the second layer, and the teeth that come out late, meeting, while they are soft, with a considerable resistance to their growth in length, from those situated upon them, necessarily come out broad, and fit to make that close guard to the mouth †, which they now form.

The teeth are joined to the sockets by *gomphosis*, and the gums contribute to fix them there; as is evident by the teeth falling out when the gums are any way destroyed, or made too spongy; as in the *scurvy* or *salivations*: whence some *(a)* class this articulation with the *syssarcosis*.

The uses of the teeth are to masticate our aliment, and to assist us in the pronounciation of several letters.

Though the teeth so far agree in their structure, yet, because of some things wherein they differ, they are generally divided into three classes, *viz. incisores*, *canini*, and *molares*.

The

† Φραγμος.

(a) Drake's Anthropolog. book 4. chap. 3.

The *incisores* * are the four fore-teeth in each jaw, receiving their name from their office of cutting our aliment; for which they are excellently adapted, being each formed into a sharp cutting edge at their *base*, by their fore side turning inwards there, while they are sloped down and hollowed behind †; so that they have the form of wedges; and therefore their power of acting must be considerably increased.——Seeing in the action of the *incisores*, a perpendicular compression is only necessary, without any lateral motion, they are not so firmly fixed in their sockets as the other teeth are, each having only one short root, but that is broader from before backwards, than to either side, to have the greatest strength where it is exposed to the strongest force applied to it (*a*).

The *incisores* of the upper jaw, especially the two middle ones ‡, are broader and longer generally than those of the under jaw.

In a new born infant, the outer shell of the body of these teeth is only hardened.——Afterwards, when the *stamina* of two sets are formed, each has its own socket, those nearest to the edge of the gums being placed more forward, and the others are lodged farther back within the jaw-bones.

Canini

* Γελαστῖνοι, τομικοὶ, δικχοῦπες, κτίνες, τομεῖς, πρωτοδιοί, ὀξεῖς, riforii, quaterii, primi, primores, anteriores, acuti.

† Ὀλμίσκος.

(*a*) Lettre sur l'osteologie, ascribed to Du Verney.

‡ Duales.

Canini *, from the resemblance to dogs tusks, are one on each side of the *incisores* in each jaw.——The two in the upper jaw are called *eye-teeth*, from the communication of nerves which is said to be betwixt them and the eyes.——The two in the lower jaw are named *angular* or *wike-teeth*, because they support the angles of the mouth.

The *canini* are broader, longer, and stronger, than the *incisores*.——Their bases are formed into a sharp edge, as the *incisores* are; only that the edge rises into a point in the middle.—Each of them has generally but one long root, tho' sometimes they have two (*a*). The roots are crooked twards the end.——The *canini* of the upper jaw are larger, longer, and with more crooked roots, than those of the under jaw.——The form of their base is fit both for piercing and cutting, and the long crooked root of each makes it secure in the socket.

The *canini* of a child are in much the same condition as the *incisores* are.

The *dentes molares*, or *grinders* †, which have got their name because they grind our food, are generally five in each side of each jaw; in all twenty. Their bases are broader, more scabrous, and with a thinner cortical substance, than the other teeth. They have also more roots, and as these roots generally divaricate from each other, the partitions of the sockets between them bear a large share of the great

* Κυνόδοντες, risorii, fractorii, collaterales, collumellares.

(*a*) Fauchard, Chirurgien dentiste, chap. 1.

† Μυλιται, γόμφοι, μύλοι, πλατῆς, φραξῆρες, maxillares, mensales, clavales, buccarum.

great preſſure they ſuffer, and hinder it to act on their points (*a*).

The baſe of the firſt grinder has an edge pointed in the middle, on its outſide, reſembling the *canini;* from which it ſlops inwards till it riſes again into a point.——It has generally but one root, which ſometimes is long and crooked at its point.

The ſecond *dens molaris* has two points on its baſe, riſing near equally on its out and inſide.——It has two roots, either ſeparate or run together, but ſhorter than the root of the firſt.——Theſe two anterior grinders are much ſmaller than the three that are placed farther back in the mouth.

The third and fourth are very broad in their baſes, with four or five points ſtanding out; and they have three or more roots.

The fifth, called commonly *dens ſapientiæ* *, from its coming through the gums later than the other grinders, has four points on its baſe, which is not ſo large as the baſe of the third and fourth, and its roots are leſs numerous.

The *inciſores* of the upper jaw, being broader than thoſe of the lower jaw, make the ſuperior grinders to be placed ſo much farther back than the lower ones, that when they are brought together, by ſhutting the mouth, the points of the grinders of the one jaw enter into the depreſſions of the oppoſite grinders, and they are all equally applied to each other, notwithſtanding the inequality of their ſurface.

The

(*a*) Lettre ſur l'oſteologie.

* Σωφρονισῆρες, κραντῆρες, ὀψιγονοι, ſenſus, intellectus, ſerotini, ætatem complentes, genuini, moderatores.

The numerous roots of the *dentes molares* prevent their loosening by the lateral pressure they suffer in grinding; and as the sockets in the upper jaw are more spongy, and the teeth are more liable, by their situation, to fall out (*a*), the grinders there have more numerous and more separated roots than in the lower jaw (*b*). The number however of the roots of the teeth of both jaws is very uncertain; sometimes they are more, sometimes fewer; frequently several roots are joined together; at other times they are all distinct. The disposition of such as are distinct is also various; for in some the roots stand out streight, in others they separate, and in others again they are crooked inwards. When the roots are united, we can still distinguish them, by remarking the number of small holes at their points, which determine the number of roots each tooth ought to be reckoned to have.

At the time of birth, only two *dentes molares* in each jaw have begun to ossify, and that at little more than the base, which has several sharp points standing out from it.—The temporaneous grinders are placed more directly upon the internal set than the other two classes are; sometimes there is a piece of the bone of the jaws between the two sets; in other children, the two sets have no bone interposed between them.

From what has been said, the answers to the following queries may be given.

(*a*) Galen. de ossib. cap. 3.
(*b*) Fauchard. Chirurg. dent. chap. 1.

Why are children subject to salivation, fever, convulsion, vomiting, purging, *&c.* when their teeth are breeding or cutting the gums?

Why in children do the *dentes incisores* first cut the gums, the *canini* next, and *molares* last?

Why do children shed their teeth?

Wherefore have these *temporaneous* teeth generally no roots, or very small ones?

Why have these first teeth sometimes roots, and that more frequently in teeth pulled by art than in those which are shedded by nature (*a*)?

Why do these roots frequently come outwards through the gums?

Whence come *butter* or *buck* teeth?

How do these teeth sometimes go into the natural row with the others, after pulling a rotten tooth near them?

How have some people got two rows of teeth in one or both jaws (*b*)?

Why do the teeth of old people loosen, and then drop out entire?

Whence arise the new setts of teeth which several old people obtain (*c*)?

Why are not the gums of toothless old people torn by the hard sockets in chewing?

Why are the teeth insensible when slightly filed or rasped?

How come they to be sensible of heat or cold, to be set on edge by acids, or to give an

(*a*) Fauchard. Chirurgien dentiste, p. 7.
(*b*) Blas. comment. ad Vesling. Syntagm. cap. 1. 3.
(*c*) Hoffman. in Van. Horn microcosm. p. 38.

an uneasy sensation when gritty or sandy substances are rubbed between them?

Why does a person who has a pained tooth imagine it longer than any other?

What is the reason of some persons dying convulsed, upon rasping or filing down an overgrown tooth (*a*).

How do the teeth break and moulder away without any pain in some people and not in others?

What parts are affected in the tooth-ach?

What are the causes of the tooth-ach?

May worms be reckoned among these causes (*b*)?

Why are the *dentes molares* most subject to that disease?

In what different manners ought the several classes of teeth to be extracted when such an operation is necessary?

Whence proceeds the violent obstinate *hemorrhagy* which sometimes attends the drawing of teeth (*c*)?

Why is it more difficult and dangerous to draw the eye-teeth than any other?

What makes it impossible frequently to draw *grinders* without bringing away part of the jaw-bone with them, or breaking the fangs?

(*a*) Bartholin. Anat. reformat. lib. 4. cap. 12.

(*b*) Jacob. in Act. Hafn. vol. 5. obs. 107.—Pechlin. Observ. medic. lib. 2. obs. 36.—Bartholin. Hist. medic. cent. 3. hist. 96.

(*c*) Pare livre 6. chap. 2.——Rolfinc. lib. 2. cap. 27. et 30.---Moebii Fundam. medicin. cap. 9.---Ephemerid. German. dec. 1. ann. 3. obs. 319.---Fauch. Chirurg. dentiste, tom. 1. chap. 23. observ. 7.

Why do teeth ſoon replaced after being extracted, become again fixed in the ſockets (*a*)?

According to the diviſion made of the ſkeleton, we ſhould now proceed to the deſcription of the trunk of the body. But muſt firſt conſider a bone, which cannot well be ſaid to belong to either the head or the trunk; nor is it immediately joined to any other, and therefore is very ſeldom preſerved with ſkeletons. However, it is generally deſcribed by authors after the bones of the face: In obedience therefore to the prevailing method, I ſhall next examine the ſtructure of

The *OS HYOIDES* *, which is ſituated horizontally betwen the root of the tongue and the *larynx*. It is properly enough named *hyoides*, from the reſemblance it bears to the *Greek* letter *υ*, and may, for a clearer demonſtration of its ſtructure, be diſtinguiſhed into its *body*, *cornua*, and *appendices*.

The body is the middle broad part, convex before, and hollow behind.——The convex fore-part is divided into two, by a ridge, into the middle of which the *mylo-hyoidei*, and into the ſides the *ſtylo-hyoidei*, muſcles are inſerted.——Above the ridge, the bone is horizontal, but pitted in the middle by the inſertion of the two *genio-hyoidei* muſcles, and a little hollowed more laterally by the *baſio-gloſſi*.——Below the ridge, it is convex, but a little

(*a*) De la Motte Chirurgie, tom. 1. chap. 4. obſ. 2.——Fauchard, Chirurgien dentiſte, tom. 1. chap. 29.

* Hypſyloides Lambdoides, παρεσφάτη, Φαρογγετερου, os gutturis, os linguæ, os morſus Adami, aſſeſſor, os laude, bicorne.

little flatted in the middle by the *sterno-hyoidei*, and pitted more externally by the *coraco-hyoidei*.——The concavity behind faces backwards and downwards to receive the *thyroid* cartilage, when the *larynx* and the *os hyoides* are pulled towards each other by the action of the *sterno-hyoidei* and *hyothyroidei* muscles; and to its upper edge, the ligamentous membranes of the *epiglottis*, tongue, and *thyroid* cartilage, are fixed.

The *cornua* of the * *os hyoides* are stretched backwards from each side of its body, where often a small furrow points out the former separation; for in young subjects, the body and *cornua* are not one continued substance, as they come afterwards to be in adults.——These *cornua* are not always streight, nor of equal length; their two plain surfaces stand obliquely sloping from above outwards and downwards. ——Into the external, the *cerato glossus* is inserted above, and the *thyro-hyoideus* muscle below; and to the one behind, the ligamentous membrane of the tongue and *larynx* adheres. Each of the *cornua* becomes gradually smaller, as it is extended from the base; but ends in a round tubercle, from which a moveable cartilage stands out, which is connected to the upper process of the *catilago thyroidea*.

Where the body of the *os hyoides* joins on each side with its *cornua*, a small styliform process, called *appendix* †, rises upwards and backwards, into which the *musculi stylo-hyoidei alteri*, and part of the *hyo-glossi* muscles are fix-

* Crura, latera inferiora.

† Crura superiora, latera superiora, ossa graniformia.

ed. From each of them a ligament is sometimes extended to the *styloid* processes of the temporal bones, to keep the *os hyoides* from being drawn too much forewards or downwards. The part of this ligament next to these processes sometimes forms into several cartilages, which afterwards ossify in old people. *Ruysch* (*a*) says that he has seen this ossification continued as far up as the styloid processes, which were therefore joined to the *os hyoides* by *anchylosis*.

The substance of the *os hyoides* is cellular, but covered with a firm external plate, which is of sufficient strength to bear the actions of so many muscles as are inserted into it.

It is not articulated with any bone of the body, except by means of the muscles and ligaments mentioned.

The use of the *os hyoides*, is to serve as a solid lever for the muscles to act with, in raising or depressing the tongue and *larynx*, or in enlarging and diminishing the capacity of the *fauces*.

At birth, this bone is in a cartilaginous state; excepting a small point of bone in the middle of its body, and in each of the *cornua*.——— The *appendices* frequently remain cartilaginous many years.

OF

(*a*) Adversf. anat. dec. 3. §. 9.

OF THE TRUNK.

THE *TRUNK* consists of the *spine*, *pelvis*, and *thorax*.

The *SPINE* * is the long pile of bones extended from the *condyles* of the *occiput* to the end of the rump. It somewhat resembles two unequal pyramids joined in a common base. It is not, however, streight; for its upper part being drawn backwards by strong muscles, it gradually advances forewards, to support the *œsophagus*, vessels of the head, *&c.* Then it turns backwards, to make place enough for the heart and lungs. It is next bended forewards, to support the *viscera* of the *abdomen*. It afterwards turns backwards, for the enlargement of the *pelvis*. And lastly, it is reflected forewards, for sustaining the lowest great gut.

The *spine* is commonly divided into *true* and *false vertebræ*; the former constituting the long upper pyramid, which has its base below, while the *false vertebræ* make the shorter lower pyramid, whose base is above.

The *TRUE VERTEBRÆ* † are the twenty four upper bones of the *spine*, on which the several motions of the trunk of our bodies are performed; from which use they have justly got their name.

Each of these *vertebræ* is composed of its body and processes.

The

* Ῥαχις, νωτον ἀκανθα, ἱερα σύριγξ, σφλην, tergum, hominis carina.

† Στροφεῖς, σφόιγγες, spondyli, ossa orbiculata, ossa vertebrata, verticula.

The body is the thick ſpongy fore-part, which is convex before, concave backwards, horizontal and plain in moſt of them above and below.——Numerous ſmall holes, eſpecially on the fore and back part of their ſurface, give paſſage to their veſſels, and allow the ligaments to enter their ſubſtance———The edges of the body of each *vertebra* are covered, eſpecially at the fore-part, with a ring of bone firmer and more ſolid than the ſubſtance of the body any where elſe. Theſe rings ſeem to be joined to the *vertebræ* in the form of *epiphyſes*, but are alledged by ſome (*a*) to be the ligaments oſſified. They are of great uſe in preventing the ſpongy bodies from being broken in the motions of the trunk.

Between the bodies of each two adjoining *vertebræ*, a ſubſtance between the nature of ligament and cartilage is interpoſed; which ſeems to conſiſt of concentrical curve fibres, when it is cut horizontally; but when it is divided perpendicularly, the fibres appear oblique and decuſſating each other (*b*).—The outer part of the intervertebral ligaments is the moſt ſolid and hard; and they gradually become ſofter till they are almoſt in the form of a glairy liquor in the center; and therefore theſe ſubſtances were not improperly called *mucous ligaments* by the ancients (*c*). The external fibrous part of each is capable of being greatly extended, and of being compreſſed into a

(*a*) Fallop. Obſervat. anatom.
(*b*) Blancard, Anat. reform. cap. 32.——Weitbrecht, Syndeſmolog. ſect. 4. § 15.
(*c*) Galen, de uſu, part. lib. 12. cap. 16.

a very ſmall ſpace, while the middle fluid part is incompreſſible, or nearly ſo; and the parts of this ligament between the circumference and center approach in their properties to either, in proportion to their more ſolid or more fluid texture. The middle point is therefore a *fulcrum*, or *pivot*, on which the motion of a ball and ſocket may be made, with ſuch a gradual yielding of the ſubſtance of the ligament, in which ever direction our ſpines are moved, as ſaves the body from violent ſhocks, and their dangerous conſequences (*c*). ——This ligamento cartilaginous ſubſtance is firmly fixed to the horizontal ſurfaces of the bodies of the *vertebræ*, to connect them, in which it is aſſiſted by a ſtrong membranous ligament, which lines all their concave ſurface, and by ſtill a ſtronger ligament that covers all their anterior convex ſurface.

We may lay it down as a general rule, notwithſtanding ſome exceptions, That the *bodies* of the *vertebræ* are ſmaller, and more ſolid above, but as they deſcend, they appear larger and more ſpongy; and that the cartilages between them are thick, and the ſurrounding ligaments ſtrong in proportion to the largeneſs of the *vertebræ*, and to the quantity of motion they perform: By which diſpoſition, the greater weight is ſupported on the broadeſt beſt ſecured baſe, and the middle of our body is allowed a large and ſecure motion.

From each ſide of the body of each *vertebra*, a bony bridge is produced backwards, and to a ſide; from the poſterior end of which, one ſlanting

(*c*) Medical eſſays and obſerv. vol. 5. art. 28.

ſlanting proceſs riſes and another deſcends; the ſmooth, and what is generally the flatteſt ſide of each of theſe four proceſſes, which are called the *oblique**, is covered with a ſmooth cartilage; and the two lower ones of each *vertebra* are fitted to, and articulated with the two upper or aſcending oblique proceſſes of the *vertebra* below, having their articular ligaments fixed into the rough line round their edges.

From between the oblique proceſſes of each ſide the *vertebra* is ſtretched out laterally into a proceſs that is named *tranſverſe*.

From the back-part of the roots of the two oblique, and of the tranſverſe proceſs of each ſide, a broad oblique bony plate is extended backwards, where theſe meet, the ſeventh proceſs of the *vertebræ* takes its riſe, and ſtands out backwards: This being generally ſharp pointed and narrow edged, has therefore been called *ſpinal* proceſs; from which this whole chain of bones has got its name.

Beſides the common ligament which lines all the internal ſurface of the ſpinal proceſſes, as well as of the bodies, there are particular ligaments that connect the bony bridges and proceſſes of the contiguous *vertebræ* together.

The ſubſtance of the proceſſes is conſiderably ſtronger and firmer, and has a thicker external plate than the bodies of the *vertebræ* have.

The ſeven proceſſes form a concavity at their fore-part, which, joined to the one at the back-part of the bodies, makes a great hole, and the holes of all the *vertebræ* form a long large

* Articulatorii, minimi.

large conduit *, for containing the *ſpinal marrow*.——In the upper and lower edge of each *lateral bridge*, there is a notch. Theſe are ſo adapted to each other in the contiguous *vertebræ*, as to form a round hole in each ſide between each two *vertebræ*, through which the nerves that proceed from the *ſpinal* marrow and its blood veſſels paſs.

The articulations then of theſe *true vertebræ* are plainly double; for their bodies are joined by the interveening cartilage above deſcribed, and their oblique proceſſes being tipped with cartilages, are ſo connected by their ligaments, as to allow a ſmall degree of motion to all ſides. Hence it is evident, that their center of motion is altered in different poſitions of the trunk: For when we bow forewards, the upper moved part bears entirely on the bodies of the *vertebræ*: If we bend back, the oblique proceſſes ſupport the weight: If we recline to one ſide, we reſt upon the oblique proceſſes of that ſide and part of the bodies: If we ſtand erect, all the bodies and oblique proceſſes have their ſhare in our ſupport.

Hence it follows, 1. That becauſe the joints of which the ſpine is compoſed are ſo numerous, the *ſpinal* marrow, nerves, blood-veſſels, *&c.* are not liable to ſuch compreſſion and over-ſtretching in the motion of the trunk of the body, as they would otherwiſe be, ſince ſeveral *vertebræ* muſt be concerned in every motion of the ſpine; and therefore a very ſmall curvature is made at the conjunction of any two

* Ιερα συριγξ, σωλην, Canalis.

two *vertebræ* (*a*). 2. That an erect posture is the surest and firmest, because the surface of contact of the *fulcra* is largest, and the weight is most perpendicular to them (*b*). 3. That the muscles which move the spine act with greater force in bringing the trunk to an erect posture, than in drawing it to any other: for in bending forewards, backwards, or to a side, the muscles which perform any of these actions are nearer the center of motion; consequently the lever with which they act is shorter, than when the center of motion is on the part of the *vertebra*, opposite to that where these muscles are inserted; which is the case in raising the trunk. This is extremely necessary; since in the deflections of the spine from a perpendicular bearing, the weight of the body soon inclines it which way we design; whereas, in raising us erect, this great weight must be more than counteracted. 4. In calculating the force exerted by the muscles which move the spine, we should always make allowance for the action of the cartilages between the *vertebræ*, which, in every motion from an erect posture, must be stretched on one side, and compressed on the other, to both which they resist; whereas, in raising the trunk, these cartilages assist by their springy force (*c*). 5. We are hence naturally led into the reason of our heighth of stature increasing in the morning

(*a*) Galen de usu part. lib. 12. cap. 12.
(*b*) Paaw de ossib. par. 2. cap. 2.
(*c*) Borelli, de motu animal. pars. 1. schol. ad propos. 58. Parent. Histoire de l'acad. des sciences, 1702.

g, and diminiſhing at night (*a*): for the intermediate cartilages of the *vertebræ* being preſſed all day long by the weight of our body, become more compact and thin in the evening; but when they are relieved from this preſſure in the night, they again expand themſelves to their former thickneſs; and ſeeing the bulk of any part muſt vary according to the different diſtenſion or repletion of the veſſels compoſing it, we may underſtand how we become taller after a plentiful meal, and decreaſe after faſting or evacuations (*b*). 6. From the different articulations of the bodies, and oblique proceſſes of the *vertebræ*, and the different ſtrength of the ligaments, it is plain, that they are formed ſo as to allow much larger motion forewards than backwards; this laſt being of much leſs uſe, and might be dangerous, by overſtretching the large blood-veſſels that are contiguous to the bodies of the *vertebræ* (*c*). 7. The intervertebral cartilages ſhrivelling as they become more ſolid by age, is the cauſe why old people generally bow forewards, and cannot raiſe their bodies to ſuch an erect poſture as they had in their youth.

The *true vertebræ* ſerve to give us an erect poſture; to allow ſufficient and ſecure motion to the head, neck, and trunk of the body, and to ſupport and defend the bowels, and other ſoft parts.

At the ordinary time of birth, each *vertebra* conſiſts of three bony pieces, connected by

(*a*) Waſſe Philoſoph. tranſact. numb. 383, art. 1.
(*b*) Abbe Fontenu Hiſtoire de l'acad. des ſciences 1725.
(*c*) Galen. de uſu part. lib. 1. cap. 16.

cartilages; to wit, the *body*, which is not fully offified, and a long crooked bone on each fide: on which we fee a fmall fhare of the bony bridge, the oblique proceffes compleat, the beginning tranfverfe proceffes, and the oblique plate, but no fpinal proceffes, fo that the teguments are in no danger of being hurt by the fharp ends of thefe fpinal proceffes; while a child is in its bended poſture in the womb, nor while it is fqueezed in the birth.

From this general mechaniſm of the ſpine, an account is eaſily deduced of all the different preternatural curvatures which the ſpine is capable of: for if one or more *vertebræ*, or their cartilages, are of unequal thickneſs in oppoſite ſides, the ſpine muſt be reclined over to the thinner ſide; which now ſuſtaining the greateſt ſhare of the weight, muſt ſtill be more compreſſed, conſequently hindered from extending itſelf in proportion to the other ſide, which, being too much freed of its burden, has liberty to enjoy a luxuriant growth. The cauſes on which ſuch an inequality of thickneſs in different ſides of the *vertebræ* depends may vary: for either it may be owing to an over-diſtenſion of the veſſels of one ſide, and from thence a preternatural increaſe of the thickneſs of that part; or which more commonly is the caſe, it may proceed from an obſtruction of the veſſels, by which the application of proper nouriſhment to the bony ſubſtance is hindered, whether that obſtruction depends on the faulty diſpoſition of the veſſels or fluids; or if it is produced by an unequal mechanical preſſure, occaſioned by a paralytic weak-

weakneſs of the muſcles and ligaments, or by a ſpaſmodic over-action of the muſcles on any ſide of the ſpine, or by people continuing long, or putting themſelves frequently into any poſture declining from the erect one: In all theſe caſes one common effect follows, to wit, the *vertebræ*, or their cartilages, or both, turn thick on that ſide where the veſſels are free, and remain thin on the other ſide where the veſſels are ſtraitened or obſtructed.——Whenever any morbid curvature is thus made, a ſecond turn, but in an oppoſite direction to the former, muſt be formed; both becauſe the muſcles on the convex ſide of the ſpine being ſtretched, muſt have a ſtronger natural contraction to draw the parts to which their ends are fixed, and becauſe the patient makes efforts to keep the center of gravity of the body perpendicular to its baſe, that the muſcles may be relieved from a conſtant violent contractile ſtate, which always creates uneaſineſs and pain.

When once we underſtand how theſe crooked ſpines are produced, there is little difficulty in forming a juſt prognoſis; and a proper method of cure may be eaſily contrived, which muſt vary as to the internal medicines, according to the different cauſes on which the diſeaſe depends: But one general indication muſt be purſued by ſurgeons; which is, to counteract the bending force, by increaſing the compreſſion on the convex part of the curvature, and diminiſhing it on the concave ſide. The manner of executing which in particular caſes muſt be different, and requires a very accurate exa-

mination of the circumstances both of the disease and patient. In many such cases, I have found some simple directions, as to postures in which the patient's body should be kept, of very great advantage.

Though the *true vertebræ* agree in the general structure which I have hitherto described; yet because of several specialities proper to a particular number, they are commonly divided into three classes, *viz. cervical, dorsal,* and *lumbar.*

The *cervical* * are the seven uppermost *vertebræ*; which are distinguished from the rest by these marks.——Their bodies are smaller and more solid than any others, and flatted on the fore-part, to make way for the *œsophagus*; or rather this flat figure is owing to the pressure of that pipe, and to the action of the *longi colli* and anterior *recti* muscles.——They are also flat behind, where small processes rise, to which the internal ligaments are fixed.——The upper surface of the body of each *vertebra* is made hollow, by a slanting thin process which is raised on each side:——The lower surface is also excavated, but in a different manner; for here the posterior edge is raised a little, and the one before is produced a considerable way.——Hence we see how the cartilages between those bones are firmly connected, and their articulations are secure.

The cartilages between these *vertebræ* are thick, especially at their fore-part; which is one

* Τραχηλος, αὐχὴν colli.

one reason why the *vertebræ* advance foreward as they descend, and have larger motion.

The oblique processes of these bones of the neck more justly deserve that name than those of any other *vertebræ*. They are situated slanting; the upper ones having their smooth and almost flat surfaces facing obliquely backwards and upwards, while the inferior oblique processes have these surfaces facing obliquely forewards and downwards.

The transverse processes of these *vertebræ* are framed in a different manner from those of any other bones of the spine: For besides the common transverse process rising from between the oblique processes of each side, there is a second one that comes out from the side of the body of each *vertebra*; and these two processes, after leaving a circular hole for the passage of the cervical artery and vein, unite, and are considerably hollowed at their upper part, with rising sides, to protect the nerves that pass in the hollow; and at last each side terminates in an obtuse point, for the insertion of muscles.

The spinal processes of these cervical bones stand nearly streight backwards, are shorter than those of any other *vertebræ*, and are forked or double at their ends; and hence allow a more convenient insertion to muscles.

The thick cartilages between the bodies of these *cervical vertebræ*, the obliquity of their *oblique* processes, and the shortness and horizontal situation of their *spinal* processes, all conspire to allow them large motion.

The holes between the bony croſs bridges, for the paſſage of the nerves from the *ſpinal marrow*, have their largeſt ſhare formed in the loweſt of the two *vertebræ*, to which they are common.

So far moſt of the cervical *vertebræ* agree; but they have ſome particular differences, which oblige us to conſider them ſeparately.

The firſt, from its uſe of ſupporting the head, has the name of *atlas* *; and is alſo called *epiſtrophea*, from the motion it perfoms on the ſecond.

The *atlas*, contrary to all the other *vertebræ* of the ſpine, has no body; but, inſtead of it, there is a bony arch.——In the convex fore-part of which, a ſmall riſing appears, where the *muſculi longi colli* are inſerted; and, on each ſide of this protuberance, a ſmall cavity may be obſerved, where the *recti interni minores* take their riſe.———The upper and lower parts of the arch are rough and unequal, where the ligaments that connect this *vertebra* to the *os occipitis*, and to the ſecond *vertebra* are fixed.--The back-part of the arch is concave, ſmooth, and covered with a cartilage, in a recent ſubject, to receive the tooth-like proceſs of the ſecond *vertebra*.——In a firſt *vertebra* from which the ſecond has been ſeparated, this hollow makes the paſſage for the *ſpinal* marrow to ſeem much larger than it really is: On each ſide of it a ſmall rough ſinuoſity may be remarked, where the ligaments going to the ſides of the tooth-like proceſs of the following *vertebra*.

* Ἀσφάγγελος.

vertebra are fastened; and on each side, a small rough protuberance and depression is observable, where the transverse ligament, which secures the tooth-like process in the sinuosity, is fixed, and hinders that process from injuring the *medulla spinalis* in the flections of the head.

The *atlas* has as little spinal process as body; but, instead thereof, there is a large bony arch, that the muscles which pass over this *vertebra* at that place might not be hurt in extending the head. On the back and upper part of this arch there are two depressions where the *recti postici minores* take their rise; and at the lower part are two other sinuosities, into which the ligaments which connect this bone to the following one are fixed.

The superior oblique processes of this *atlas* are large, oblong, hollow, and more horizontal than in any other *vertebra*.——They rise more in their external than internal brim; by which their articulations with the *condyloid* processes of the *os occipitis* are firmer.——Under the external edge of each of these oblique processes, is the *fossa* or deep open channel, in which the vertebral arteries make the circular turn, as they are about to enter the great *foramen* of the occipital bone, and where the tenth pair of nerves goes out.———In several bodies, I have seen this *fossa* covered with bone.——The inferior oblique processes extending from within outwards and downwards, are large, concave, and circular. So that this *vertebra*, contrary to the other six, receives the bones with

with which it is articulated both above and below.

The tranſverſe proceſſes here are not much hollowed or forked, but are longer and larger than thoſe of any other *vertebra* of the neck, for the origin and inſertion of ſeveral muſcles; of which thoſe that ſerve to move this *vertebra* on the ſecond have a conſiderable lever to act with, becauſe of the diſtance of their inſertion from the *axis* of revolution.

The hole for the *ſpinal marrow* is larger in this than in any other *vertebra*, not only on account of the *marrow* being largeſt here, but alſo to prevent its being hurt by the motions of this *vertebra* on the ſecond one. —— This large hole, and the long tranſverſe proceſſes, make this the broadeſt *vertebra* of the neck.

The *condyles* of the *os occipitis* move forewards and backwards in the ſuperior oblique proceſſes of this *vertebra*; but from the figure of the bones forming theſe joints, it appears, that very little motion can here be allowed to either ſide; and there muſt be ſtill leſs circular motion.

In new-born children this *vertebra* has only the two lateral pieces offified; the arch, which it has at its fore-part inſtead of a body, being cartilaginous.

The ſecond *vertebra colli* is called *dentata*, from the tooth like proceſs on the upper part of its body. Some authors call it *epiſtrophea*, but improperly, ſince this deſignation is only applicable to the firſt, which moves on this as on an axis.

The

The body of this *vertebra* is somewhat of a pyramidal figure, being large, and produced downwards, especially at its fore-side, to enter into a hollow of the *vertebra* below; while the upper part has a square process with a small point standing out from it. This it is that is imagined to resemble a tooth *, and has given name to the *vertebra*.——The side of this process, on which the hollow of the anterior arch of the first *vertebra* plays, is convex, smooth, and covered with a cartilage; and it is of the same form behind, for the ligament, which is extended transversely from one rough protuberance of the first *vertebra* to the other, and is cartilaginous in the middle, to move on it.—A ligament likewise goes out in an oblique transverse direction, from each side of the *processus dentatus*, to be fixed at its other end to the first *vertebra*, and to the occipital bone: and another ligament rises up from near the point of the process to the *os occipitis*.

The superior oblique processes of this *vertebra dentata* are large, circular, very nearly in an horizontal position, and slightly convex, to be adapted to the inferior oblique processes of the first *vertebra*.—A moveable cartilage is said by some authors to be interposed between these oblique processes of the first and second *vertebra*; but I could never find it —— The inferior oblique processes of this *vertebra dentata* answer exactly to the description given of those common to all the cervical *vertebræ*.

The

* Conoides, pyrenoides, odontoides.

The transverse processes of the *vertebra dentata* are short, very little hollowed at their upper part, and not forked at their ends; and the canals through which the cervical arteries pass, are reflected outwards about the middle substance of each process; so that the course of these vessels may be directed towards the transverse processes of the first *vertebra*.—Had this curvature of the arteries been made in a part so moveable as the neck is, while they were not defended by a bone, and fixed to that bone, scarce a motion could have been performed without the utmost hazard of compression, and a stop put to the course of the liquids, with all its train of bad consequences. Hence we observe this same mechanism several times made use of, when there is any occasion for a sudden curvature of a large artery. This is the third remarkable instance of it we have seen. The first was the passage of the *carotids* through the *temporal* bones; and the second was that lately described in the vertebral arteries, turning round the oblique processes of the first *vertebra*, to come at the great hole of the occipital bone.

The spinal process of this *vertebra dentata* is thick, strong, and short, to give sufficient origin to the *musculi recti majores*, and *obliqui inferiores*, and to prevent the contusion of these and other muscles in pulling the head back.

This second *vertebra* consists, at the birth, of four bony pieces: For, besides the three which I already mentioned as common to all the *vertebræ*, the tooth-like process of this bone is begun at this time to be ossified in its middle,

middle, and is joined as an appendix to the body of the bone.——Left this appendix be bended or displaced, nurses ought to keep the heads of new born children from falling too far backwards by *stay-bands*, or some such means, till the muscles attain strength sufficient to prevent that dangerous motion.

When we are acquainted with the structure and articulations of the first and second *vertebræ*, and know exactly the strength and connection of their ligaments, there is no difficulty in understanding the motions that are performed upon or by the first; though this subject was formerly matter of hot dispute among some of the greatest anatomists (*a*). It is none of my purpose at present to enter into a detail of the reasons advanced by either party; but to explain the fact, as any one may see it, who will remove the muscles, which, in a recent subject, hinder the view of these two joints, and then will turn the head into all the different positions it is capable of. The head may then be seen to move forewards and backwards on the first *vertebra*, as was already said, while the *atlas* performs the *circumgyratio* upon the second *vertebra*; the inferior oblique processes of the first *vertebra* shuffling easily in a circular way on the superior oblique processes of the second, and its body or anterior arch having a rotation on the tooth-like process, by which the perpendicular ligament that is sent from the point of the tooth-like process to the occipital bone is twisted, while the lateral ligaments, that fix the *processus dentatus* to

(*a*) See Eustach. de motu capitis.

to the sides of the first *vertebra*, and to the *os occipitis*, are very differently affected; for the one upon the side towards which the face is turned by the *circumgyratio*, is much shortened and lax, while the opposite one is stretched and made tense, and yielding at last no more, prevents the head from turning any further round on this *axis*. So that these lateral ligaments are the proper *moderators* of the *circumgyratio* of the head here, which must be larger or smaller, as these ligaments are weaker or stronger, longer or shorter, and more or less capable of being stretched.——Besides the revolution on this *axis*, the first *vertebra* can move a small way to either side; but is prevented from moving backwards and forewards, by its anterior arch, and by the cross ligament, which are both closely applied to the tooth-like process. Motion forewards here would have been of very bad consequence, as it would have brought the beginning of the *spinal* marrow upon the point of the tooth-like process.

The rotatory motion of the head is of great use to us on many accounts, by allowing us to apply quickly our organs of the senses to objects: and the *axis* of rotation was altogether proper to be at this place; for if it had been at a greater distance from the head, the weight of the head, if it had at any time been removed from a perpendicular bearing to the small very moveable joint, and thereby had acquired a long lever, would have broke the ligaments at every turn inconsiderately performed: or these ligaments must have been formed much stronger than could have been connect-

ed

ed to such small bones. Neither could this circular motion be performed on the first *vertebra* without danger, because the immoveable part of the *medulla oblongata* is so near, as at each large turn, the beginning of the *spinal* marrow would have been in danger of being twisted, and of suffering by the compression this would have made on its tender fibrils.

It is necessary to observe, that the *lateral* or *moderator* ligaments confine so much the motion of the first *vertebra* upon the second, that, though this joint may serve us on several occasions, yet we are often obliged to turn our faces farther round, than could be done by this joint alone, without the greatest danger of twisting the spinal marrow too much, and also of luxating the oblique processes; therefore, in large turns of this kind, the rotation is assisted by all the *vertebræ* of the neck and loins; and if this is not sufficient, we employ most of the joints of the lower extremities.——This combination of a great many joints towards the performance of one motion, is also to be observed in several other parts of the body; notwithstanding such motions being generally said to be performed by some single joint only.

The third *vertebra* of the neck is by some called *axis;* but this name is applied to it with much less reason than to the second.—— This third, and the three below, have nothing particular in their structure; but all their parts come under the general description formerly given, each of them being larger as they descend.

The ſeventh * *vertebra* of the neck is near to the form of thoſe of the back, having the upper and lower ſurfaces of its body leſs hollow than the others :——The oblique proceſſes are more perpendicular ;—neither ſpinal nor tranſverſe proceſſes are forked.—This ſeventh and the ſixth *vertebræ* of the neck have the hole in each of their tranſverſe proceſſes more frequently divided by a ſmall croſs bridge, that goes between the cervical vein and artery, than any of the other *vertebræ*.

The twelve *dorſal* † may be diſtinguiſhed from the other *vertebræ* of the ſpine by the following marks.

Their bodies are of a middle ſize, betwixt thoſe of the neck and loins ;——they are more convex before than either of the other two ſorts ; and are flatted laterally by the preſſure of the ribs, which are inſerted into ſmall cavities formed in their ſides. This flatting on their ſides, which makes the figure of theſe *vertebræ* almoſt an half oval, is of good uſe; as it affords a firm articulation to the ribs, allows the *trachea arteria* to divide at a ſmall angle, and the other large veſſels to run ſecure from the action of the vital organs.—Theſe bodies are more concave behind than any of the other two claſſes.—Their upper and lower ſurfaces are horizontal.

The cartilages interpoſed between the bodies of theſe *vertebræ* are thinner than in any other of

* Atlas quibuſdam, maxima, magna vertebra, prominens.

† Θώρακος μεταφρένα νῶτα ὑποτραχήλια antiſterni, pectoris, tergi.

of the *true vertebrae*; and contribute to the concavity of the spine in the thorax, by being thinneſt at their fore-part.

The *oblique* proceſſes are placed almoſt perpendicular; the upper ones ſlanting but a little forewards, and the lower ones ſlanting as much backwards.—They have not as much convexity or concavity as is worth remarking.——— Between the oblique proceſſes of oppoſite ſides, ſeveral ſharp proceſſes ſtand out from the upper and lower parts of the plates which join to form the ſpinal proceſs; into theſe ſharp proceſſes ſtrong ligaments are fixed, for connecting the *vertebræ*.

The *tranſverſe* proceſſes of the *dorſal vertebræ* are long, thicker at their ends than in the middle, and turned obliquely backwards; which may be owing to the preſſure of the ribs, the tubercles of which are inſerted into a depreſſion near the end of theſe proceſſes.

The *ſpinal* proceſſes are long, ſmall pointed, and ſlopping downwards and backwards; from their upper and back-part a ridge riſes, which is received by a ſmall channel in the fore-part of the ſpinal proceſs immediately above, which is here connected to it by a ligament.

The *conduit* of the *ſpinal* marrow is here more circular, but, correſponding to the ſize of that cord, is ſmaller than in any of the other *vertebræ*, and a larger ſhare of the holes in the bony bridges, for the tranſmiſſion of the nerves, is formed in the *vertebra* above, than in the one below.

The connection of the *dorſal vertebræ* to the ribs, the thinneſs of their cartilages, the

erect situation of the oblique processes, the length, sloping, and connection of the spinal processes, all contribute to restrain these *vertebræ* from much motion, which might disturb the actions of the heart and lungs; and, in consequence of the little motion allowed here, the *intervertebral* cartilages sooner shrivel, by becoming more solid: And therefore, the first remarkable curvature of the spine observed, as people advance to old age, is in the least stretched *vertebrae* of the back; or old people first become round shouldered.

The bodies of the four uppermost *dorsal vertebrae* deviate from the rule of the *vertebrae* becoming larger as they descend; for the first of the four is the largest, and the other three below gradually become smaller, to allow the *trachea* and large vessels to divide at smaller angles.

The two uppermost *vertebrae* of the back, instead of being very prominent forewards, are flatted by the action of the *musculi longi colli* and *recti majores*.

The proportional size of the two little depressions in the body of each *vertebra* for receiving the heads of the ribs, seems to vary in the following manner; the depression on the upper edge of each *vertebra* decreases as far down as the fourth, and after that increases.

The transverse processes are longer in each lower *vertebra* to the seventh or eight, with their smooth surfaces, for the tubercles of the ribs, facing gradually more downwards; but afterwards as they descend they become shorter,

and

and the ſmooth ſurfaces are directed more upwards.

The ſpinous proceſſes of the *vertebrae* of the back become gradually longer and more ſlanting from the firſt, as far down as the eight or ninth *vertebra*; from which they manifeſtly turn ſhorter and more erect.

The firſt * *vertebra*, beſides an oblong hollow in its lower edge, that aſſiſts in forming the cavity wherein the ſecond rib is received, has the whole cavity for the head of the firſt rib formed in it.

The ſecond has the name of *axillary* †, without any thing particular in its ſtructure.

The eleventh ‡ often has the whole cavity for the eleventh rib in its body, and wants the ſmooth ſurface on each tranſverſe proceſs.

The twelfth ‖ always receives the whole head of the laſt rib, and has no ſmooth ſurface on its tranſverſe proceſſes, which are very ſhort.——The ſmooth ſurfaces of its inferior oblique proceſſes face outwards as the *lumbar* do.———And we may ſay, in general, that the upper *vertebrae* of the back loſe gradually their reſemblance to thoſe of the neck, and the lower ones come nearer to the figure of the *lumbar*.

The articulation of the *vertebrae* of the back with the ribs, ſhall be more particularly conſidered after the ribs are deſcribed. Only it

* Δοφία, gutturalis.

† Μασχαλιαίς.

‡ Ἀρρεπὴς, in neutram partem inclinans.

‖ Διατωσης, præcingens.

may be proper now to remark, that the ligaments which ſerve that articulation aſſiſt in connecting the *vertebrae*.

The loweſt order of the *true vertebrae* is the *lumbar* *, which are five bones, that may be diſtinguiſhed from any others by theſe marks: 1. Their bodies, though of a circular form at their fore-part, are ſomewhat oblong from one ſide to the other; which may be occaſioned by the preſſure of the large veſſels, the *aorta* and *cava*, and of the *viſcera*. The *epiphyſes* on their edges are larger, and therefore the upper and lower ſurfaces of their bodies are more concave than in the *vertebrae* of the back. 2. The cartilages between theſe *vertebrae* are much the thickeſt of any, and render the ſpine convex within the *abdomen*, by their greateſt thickneſs being at their fore-part. 3. The oblique proceſſes are ſtrong and deep; thoſe in oppoſite ſides being almoſt placed in parallel planes; the ſuperior, which are concave, facing inwards, and the convex inferior ones facing outwards: and therefore each of theſe *vertebrae* receives the one above it, and is received by the one below; which is not ſo evident in the other two claſſes already deſcribed. 4. Their tranſverſe proceſſes are ſmall, long, and almoſt erect, for allowing large motion to each bone, and ſufficient inſertion to muſcles, and for ſupporting and defending the internal parts. 5. Betwixt the roots of the ſuperior oblique and tranſverſe proceſſes, a ſmall protuberance may be obſerved, where

* Ὀσφὺς ἰξύες, ψοΐαν, renum, lumborum.

where ſome of the muſcles that raiſe the trunk of the body are inſerted. 6. Their ſpinal proceſſes are ſtrong, ſtreight, and horizontal, with broad flat ſides, and a narrow edge above and below; this laſt being depreſſed on each ſide by muſcles. And at the root of theſe edges, we ſee rough ſurfaces for fixing the ligaments. 7. The canal for the numerous cords, called *cauda equina*, into which the ſpinal marrow divides, is rather larger in theſe bones than what contains that *marrow* in the *vertebræ* of the back. 8. The holes for the paſſage of the nerves are more equally formed out of both the contiguous *vertebræ* than in the other claſſes; the upper one furniſhes however the larger ſhare of each hole.

The thick cartilages between theſe *lumbar vertebræ*, their deep oblique proceſſes, and their erect ſpinal proceſſes, are all fit for allowing large motion; though it is not ſo great as what is performed in the neck; which appears from comparing the arches which the head deſcribes when moving on the neck, or the loins only.

The *lumbar vertebræ* as they deſcend, have their oblique proceſſes at a greater diſtance from each other, and facing more backwards and forewards.

Both tranſverſe and ſpinal proceſſes of the middlemoſt *vertebræ* of the loins are longeſt and thickeſt; in the *vertebræ* above and below they are leſs: So that theſe proceſſes of the firſt *

and

* Νεφριτης, renalis.

and fifth * are the leaſt, to prevent their ſtriking on the ribs or *oſſa ilium*, or their bruiſing the muſcles in the motions of the ſpine.

The *epiphyſes* round the edges of the bodies of the *lumbar vertebræ* are moſt raiſed in the two loweſt, which conſequently make them appear hollower in the middle than the others are.

The body of the fifth *verterba* is rather thinner than that of the fourth.——The ſpinal proceſs of this fifth is ſmaller, and the oblique proceſſes face more backwards and forewards than in any other *lumbar vertebræ*.

After conſidering the ſtructure of the particular *vertebræ*, and their mutual connection, we may obſerve a ſolicitous care taken that they ſhall not be disjoined, but with great difficulty; for beſides being connected by ſtrong ligaments proportioned to the forces which are to be reſiſted, their bodies either enter ſo into each other, as to prevent their being diſplaced any way, as in the *vertebræ* of the neck; or they are proped on all ſides, as theſe of the *back* are by the ribs; or their ſurfaces of contact are ſo broad, as to render the ſeparation almoſt impracticable, as in the *loins*; while the depth and articulation of the oblique proceſſes are exactly proportioned to the quantity of motion which the other parts of the bones allow, or the muſcles can perform: Yet, as theſe oblique proceſſes are ſmall, and therefore not capable of ſo ſecure a conjunction as the larger bodies, they may ſooner yield to a disjoining force; but then their diſlocation is

* Ασχαγίτης, fulciens.

is not of near so bad consequence as the separation of the bodies would be. For, by the oblique processes being dislocated, the muscles, ligaments, and *spinal* marrow are indeed stretched; but this marrow must be compressed, or entirely destroyed, when the body of the *vertebra* is removed out of its place.

The *FALSE VERTEBRÆ* compose the under pyramid of the *spine*. They are distinguished from the bones already described justly enough by this epithet of *false*; because tho' each bone into which they can be divided in young people, resembles the *true vertebræ* in figure, yet none of them contribute to the motion of the trunk of the body; they being intimately united to each other in adults, except at their lower part, where they are moveable; whence they are commonly divided into two bones, *os sacrum*, and *coccygis*.

OS SACRUM *, is so called, from being offered in sacrifice by the ancients, or rather because of its largeness in respect of the other *vertebræ*.——This bone is of an irregular triangular shape, broad above, narrow below, convex behind, for the advantageous origin of the muscles that move the *spine* and thigh backwards; and concave behind, for enlarging the cavity of the *pelvis*.——Four transverse lines of a colour different from the rest of the bone which are seen on its fore-part, are the marks of division of the five different bones of which it consists in young persons.

The

* Ἱερον, σπονδυλος μεγας Hippocrat. ὑποσπονδυλον, oribas. Πλατυ, latum, os clunium, clavium.

The fore-part of the *os ſacrum*, analogous to the bodies of the *true vertebræ*, is ſmooth and flat, to allow a larger ſpace for the contained bowels, without any danger of hurting them; or this flat figure may be owing to the equal preſſure of theſe bowels, particularly of the laſt gut.——The back part of it is almoſt ſtreight, without ſo large a cavity as the *vertebræ* have; becauſe the ſpinal marrow, now ſeparated into the *cauda equina*, is ſmall.——The bridges between the bodies and proceſſes of this bone, are much thicker, and in proportion ſhorter, than in the former claſs of bones.——The ſtrength of theſe croſs bridges is very remarkable in the three upper bones, and is well proportioned to the incumbent weight of the trunk of the body, which theſe bridges ſuſtain in a tranſverſe, conſequently an unfavourable, ſituation, when the body is erect.

There are only two oblique proceſſes of the *os ſacrum*; one ſtanding out on each ſide from the upper part of the firſt bone.——Their plain erect ſurfaces face backwards, and are articulated with the inferior oblique proceſſes of the laſt *vertebra* of the loins, to which each of theſe proceſſes is connected by a ſtrong ligament, which riſes from a ſcabrous cavity round their roots, where mucilaginous glands are alſo lodged.—Inſtead of the other oblique proceſſes of this bone, four rough tubercles are to be ſeen on each ſide of its ſurface behind, from which the *muſculus ſacer* has its origin.

The tranſverſe proceſſes here are all grown together into one large ſtrong oblong proceſs

on

on each side; which so far as it answers to the first three bones, is very thick, and divided into two irregular cavities, by a long perpendicular ridge.——The foremost of the two cavities has commonly a thin cartilaginous skin covering it in the recent subject, and is adapted to the unequal protuberance of the *os ilium*, and a strong ligament connects the circumference of these surfaces of the two bones.—The cavity behind is divided by a transverse ridge into two, where strong ligamentous strings that go from this bone to the *os ilium* with a cellular substance containing *mucus*, are lodged.

The transverse processes of the two last bones of the *os sacrum* are much smaller than the former.——At their back part near their edge, a knob and oblong flat surface give rise to two strong ligaments which are extended to the *os ischium*; and are therefore called *sacrosciatic*.

The spinal processes of the three uppermost bones of the *os sacrum* appear short, sharp, and almost erect, while the two lower ones are open behind; and sometimes a little knob is to be seen on the fourth, though generally it is bifurcated, without the two legs meeting into a spine; in which condition also the first is often to be seen; and sometimes none of them meet, but leave a *sinus*, or rather *fossa*, instead of a canal (*a*)—The *musculus latissimus* and *longissimus dorsi*, *sacrolumbalis*, and *glutaeus maximus*, have part of their origins from these spinal processes

The

(*a*) Verheyen, Anat. tract. 5. cap 9.—Sue Trad. d'osteol. p. 127.

The canal between the bodies and proceſſes of this bone, for the *cauda equina*, is triangular; and becomes ſmaller as it deſcends, as the *cauda* alſo does ——Below the third bone, this paſſage is no more a compleat bony canal, but is open behind; and is only there defended by a ſtrong ligamentous membrane ſtretched over it, which, with the muſcles that cover it, and are very prominent on each ſide, is a ſufficient defence for the bundle of nerves within.

At the root of each oblique proceſs of this bone the notch is conſpicuous, by which, and ſuch another in the laſt *vertebra* of the loins, a paſſage is left for the twenty-fourth ſpinal nerve; and, in viewing the *os ſacrum*, either before or behind, four large holes appear in each ſide, in much the ſame height, as where the marks of the union of its ſeveral Bones remain. Some of the largeſt nerves of the body paſs through the anterior holes; and ſuperficial grooves running outwards from them in different directions, ſhew the courſe of theſe nerves.——From the intervals of theſe grooves, the *pyriformis* muſcle chiefly riſes.———The holes in the back part of the bone are covered by membranes which allow ſmall nerves to paſs through them.——The two uppermoſt of theſe holes, eſpecially on the fore-ſide, are the largeſt; and as the bone deſcends, the holes turn ſmaller. Sometimes a notch is only formed at the lower part in each ſide of this bone; and in other ſubjects there is a hole common to it and the *os coccygis*, through which the twenty-ninth pair of ſpinal nerves paſſes; and frequently a bony bridge is formed on the back-

part

part of each side by a process sent up from the back-part of the *os coccygis*, and joined to the little knobs which the last bone of the *os sacrum* has instead of a spinal process. Under this bridge or *jugum*, the twenty-ninth pair of spinal nerves runs in its course to the common holes just now described.

The upper part of the body of the first bone resembles the *vertebrae* of the loins; but the small fifth bone is oblong transversely, and hollow in the middle of its lower surface.

The substance of the *os sacrum* is very spongy, without any considerable solid external plates and is lighter proportionally to its bulk than any other bone in the body; but is secured from injuries by the thick muscles that cover it behind, and by the strong ligamentous membranes that closely adhere to it.——As this is one of the most remarkable instances of this sort of defence afforded a soft weak bone, we may make the general observation, that, where-ever we meet with such a bone, one or other, or both these defences are made use of, the first to ward off injuries, and the second to keep the substance of the bone from yielding too easily.

This bone is articulated above to the last *vertebra* of the loins, in the manner that the *lumbar vertebrae* are joined; and therefore the same motions may be performed here.—— The articulation of the lower part of the *os sacrum* to the *os coccygis* seems well enough adapted for allowing considerable motion to this last bone, was it not much confined by ligaments. Laterally, the *os sacrum* is joined

to the *ossa ilium* by an immoveable *synchondrosis*, or what almost deserves the name of a suture; for the cartilaginous crust on the surface of the bones is very thin, and both their surfaces are so scabrous and unequal, as to be indented into each other: which makes such a strong connection, that great force is required to separate them, after all the muscles and ligaments are cut.——Frequently the two bones grow together in old subjects.

The uses of the *os sacrum* are, to serve as the common base and support of the trunk of the body, to guard the nerves proceeding from the end of the spinal marrow, to defend the back-part of the *pelvis*, and to afford sufficient origin to the muscles which move the trunk and thigh.

The bones that compose the *os sacrum* of infants, have their bodies separated from each other by a thick cartilage; and, in the same manner as the *true vertebrae*, each of them consists of a body and two lateral plates, connected together by cartilages; the ends of the plates seldom being contiguous behind.

*OS COCCYGIS**, or *rump bone*, is that triangular chain of bones depending from the *os sacrum*; each bone becoming smaller as they descend, till the last ends almost in a point. The *os coccygis* is convex behind, and concave before; from which crooked pyramidal figure, which was thought to resemble a cuckow's beak, it has got its name.

This

* Ὀστέον κοκκυγιον, ὄρνεος, candæ os, spondylium, os cuculi.

This bone consists of four pieces in people of middle age :——In children, very near the whole of it is cartilage : In old subjects, all the bones are united, and become frequently one continued bone with the *os sacrum*.

The highest of the four bones is the largest, with shoulders extended farther to each side than the end of the *os sacrum* ; which enlargement should, in my opinion, serve as a distinguishing mark to fix the limits of either bone ; and therefore should take away all dispute about reckoning the number of bones, of which one or other of these two parts of the *false vertebræ*, is composed ; which dispute must still be kept up, so long as the numbering five or six bones in the *os sacrum* depends upon the uncertain accident of this broad shouldered little bone being united to or separated from it.——The upper surface of this bone is a little hollow.——From the back of that bulbous part called its *shoulders*, a process often rises up on each side, to join with the bifurcated spine of the fourth and fifth bones of the *os sacrum*, to form the bony bridge mentioned in the description of the *os sacrum*.—Sometimes these shoulders are joined to the sides of the fifth bone of the *os sacrum*, to form the hole in each side common to these two bones, for the passage of the twenty ninth pair of spinal nerves.——Immediately below the shoulders of the *os coccygis*, a notch may be remarked in each side, where the thirtieth pair of the spinal nerves passes——The lower end of this bone is formed into a small head, which very often is hollow in the middle.

The three lower bones gradually become ſmaller, and are ſpongy; but are ſtrengthened by a ſtrong ligament which covers and connects them.——Their ends, by which they are articulated, are formed in the ſame manner as thoſe of the firſt bone are.

Between each of theſe four bones of young ſubjects a cartilage is interpoſed; therefore their articulation is analogous to that of the bodies of the *vertebræ* of the neck: For, as has been above remarked, the lower end of the *os ſacrum*, and of each of the three ſuperior bones of the *os coccygis*, has a ſmall depreſſion in the middle; and the upper part of all the bones of the *os coccygis* is a little concave, and conſequently the interpoſed cartilages are thickeſt in the middle, to fill up both cavities; by which they connect the bones more firmly.—When the cartilages oſſify, the upper end of each bone is formed into a cavity, exactly adapted to the protuberant lower end of the bone immediately above.——From this ſort of articulation, it is evident, that, unleſs when theſe bones grow together, all of them are capable of motion; of which, the firſt and ſecond, eſpecially this laſt, enjoys the largeſt ſhare.

The lower end of the fourth bone terminates in a rough point, to which a cartilage is appended.

To the ſides of theſe bones of the *os coccygis*, the *coccygæi* muſcles (*a*), and part of the *levatores ani*, and of the *glutæi maximi*, are fixed.

The

(*a*) Douglas, Myograph. chap. 40.--Euſtach. tab. 38. No. 45. 20.

The ſubſtance of theſe bones is very ſpongy, and in children cartilaginous; there being only a part of the firſt bone oſſified in a new-born infant.—Since therefore the *inteſtinum rectum* of children is not ſo firmly ſupported as it is in *adults*, this may be one reaſon why they are more ſubject to a *procidentia ani* than old people (*a*).

From the deſcription of this bone, we ſee how little it reſembles the *vertebræ*; ſince it ſeldom has proceſſes, never has any cavity for the *ſpinal* marrow, nor holes for the paſſage of nerves.—Its connection hinders it to be moved to either ſide; and its motion backwards and forewards is much confined: Yet, as its ligaments can be ſtretched by a conſiderable force, it is a great advantage in the excretion of the *fæces alvinæ*, and much more in child-bearing, that this bone ſhould remain moveable; and the right management of it, in delivering women, may be of great benefit to them (*b*).——The mobility of the *os coccygis* diminiſhing as people advance in age, eſpecially when its ligaments and cartilages have not been kept flexible by being ſtretched, is probably one reaſon why the women, who are old maids before they marry, have generally hard labour in child-bed.

The *os coccygis* ſerves to ſuſtain the *inteſtinum rectum*; and, in order to perform this office more effectually, it is made to turn with a

(*a*) Spigel. de humani corp. fabric. lib. 2. cap. 22.—Paaw, de oſſib. par. 2. cap. 3.

(*b*) Paaw, ibid.—Deventer, Operat. chirurg. cap. 27.

curve forewards; by which alſo the bone itſelf, as well as the muſcles and teguments, is preſerved from any injury, when we ſit with our body reclined back.

The ſecond part of the trunk of the ſkeleton, the *PELVIS*, is the cylindrical cavity at the lower part of the *abdomen*, formed by the *os ſacrum*, *os coccygis*, and *oſſa innominata*; which laſt therefore fall now in courſe to be examined.

Though the name of *OSSA INNOMINATA** contributes nothing to the knowledge of their ſituation, ſtructure, or office; yet they have been ſo long and univerſally known by it, that there is no occaſion for changing it.—They are two large broad bones, which form the fore-part and ſides of the *pelvis*, and the lower part of the ſides of the *abdomen*—In children each of theſe bones is evidently divided into three; which are afterwards ſo intimately united, that ſcarce the leaſt mark of their former ſeparation remains: This notwithſtanding, they are deſcribed as conſiſting each of three bones, to wit, the *os ilium*, *iſchium*, and *pubis*; which I ſhall firſt deſcribe ſeparately, and then ſhall conſider what is common to any two of them or to all the three.

OS ILIUM†, or *haunch bone*, is ſituated higheſt of the three, and reaches as far down as one third of the great cavity into which the head of the thigh-bone is received.

The

* Σκελίων, προσφύσεις, ſacro conjuncta.

† Δαγόνων, κίνιαν, ſcaphium, lumbare, clunium, clavium, anchas.

The external side of this bone is unequally convex, and is called its *dorsum*;—the internal concave surface is by some (but improperly) named its *costa*——The semicircular edge at the highest part of this bone, which is tipped with a cartilage in the recent subject, is named the *spine*, into which the external or descending oblique muscle of the *abdomen* is inserted; and from it the internal ascending oblique and the transverse muscles of the belly, with the *glutæus maximus*, *quadratus lumborum*, and *latissimus dorsi*, have their origin. Some (*a*) are of opinion, that it is only the tendinous crust of all these muscles, and not a cartilage, as commonly alledged, that covers this bony edge.—The ends of the spine are more prominent than the surface of the bone below them; therefore are reckoned processes.——From the anterior spinal process, the *sartorius* and *fascialis* muscles have their rise, and the outer end of the doubled tendon of the external oblique muscle of the *abdomen*, commonly called *Fallopius*'s or *Poupart*'s ligament, is fixed to it.——The inside of the posterior spinal process, and of part of the spine foreward from that, is made flat and rough where the *sacro lumbalis* and *longissimus dorsi* rise; and to its outside ligaments, extended to the *os sacrum* and transverse processes of the fifth and fourth *vertebræ* of the loins, are fixed (*b*).——Below the anterior spinal process another protuberance

(*a*) Winslow, Expositon anatomique du corps humain, traite des os frais, § 96.

(*b*) Weitbrecht, Syndesmolog. sect. 4. § 39. 40. 46. 47.

tuberance ſtands out, which, by its ſituation, may be diſtinguiſhed from the former, by adding the epithet of *inferior*, where the *muſculus rectus tibiæ* has its origin (*a*).—Betwixt theſe two anterior proceſſes the bone is hollowed where the beginning of the *ſartorius* muſcle is lodged.—Below the poſterior ſpinal proceſs, a ſecond protuberance of the edge of this bone is in like manner obſervable, which is cloſely applied to the *os ſacrum*.——Under this laſt proceſs a conſiderable large niche is obſervable in the *os ilium*; between the ſides of which and the ſtrong ligament that is ſtretched over from the *os ſacrum* to the ſharp-pointed proceſs of the *os iſchium* of the recent ſubject, a large hole is formed, through which the *muſculus-pyriformis*, the great ſciatic nerve, and the poſterior crural veſſels paſs, and are protected from compreſſion.

The external broad ſide or *dorſum* of the *os ilium* is a little hollow towards the fore-part; farther back it is as much raiſed; then is conſiderably concave; and, laſtly, it is convex. Theſe inequalities are occaſioned by the actions of the muſcles that are ſituated on this ſurface.—From behind the uppermoſt of the two anterior ſpinal proceſſes, in ſuch bones as are ſtrongly marked by the muſcles, a ſemicircular ridge is extended to the hollow paſſage of the ſciatic nerve. Between the ſpine and this ridge, the *glutæus medius* takes its riſe. Immediately from above the loweſt of the anterior ſpinal proceſſes, a ſecond ridge is

(*a*) Bake, Curſ. Oſteolog. demonſtr. 3.

is ſtretched to the niche. Between this and the former ridge, the *glutæus minimus* has its origin.——On the outſide of the poſterior ſpinal proceſſes, the *dorſum* of the *os ilium* is flat and rough, where part of the *muſculus glutæus maximus* and *pyriformis* riſes.——The loweſt part of this bone is the thickeſt, and is formed into a large cavity with high brims, to aſſiſt in compoſing the great *acetabulum*; which ſhall be conſidered, after all the three bones that conſtitute the *os innominatum* are deſcribed.

The internal ſurface of the *os ilium* is concave in its broadeſt fore-part, where the internal iliac muſcle has its origin, and ſome ſhare of the *inteſtinum ilium* and *colon* is lodged.——From this large hollow, a ſmall ſinuoſity is continued obliquely forewards, at the inſide of the anterior inferior ſpinal proceſs, where part of the *pſoas* and *iliacus* muſcles, with the crural veſſels and nerves, paſs.——The large concavity is bounded below by a ſharp ridge, which runs from behind forewards; and, being continued with ſuch another ridge of the *os pubis*, forms a line of partition between the *abdomen* and *pelvis*.——Into this ridge the broad tendon of the *pſoas parvus* is inſerted.

All the internal ſurface of the *os ilium*, behind this ridge, is very unequal: For the upper part is flat, but ſpongy, where the *ſacrolumbalis* and *longiſſimus dorſi* riſe.——Lower down, there is a tranſverſe ridge from which ligaments go out to the *os ſacrum*.——Immediately below this ridge, the rough unequal cavities

vities and prominences are placed, which are exactly adapted to thoſe deſcribed on the ſide of the *os ſacrum* ——In the ſame manner, the upper part of this rough ſurface is porous, for the firmer adheſion of the ligamentous cellular ſubſtance; while the lower part is more ſolid, and covered with a thin cartilaginous ſkin, for its immoveable articulation with the *os ſacrum*.——From all the circumference of this large unequal ſurface, ligaments are extended to the *os ſacrum*, to ſecure more firmly the conjunction of theſe bones.

The paſſages of the medullary veſſels are very conſpicuous, both in the *dorſum* and *coſta* of many *oſſa ilium*; but in others they are inconſiderable.

The poſterior and lower parts of theſe bones are thick; but they are generally exceeding thin and compact at their middle, where they are expoſed to the actions of the *muſculi glutaei* and *iliacus internus*, and to the preſſure of the bowels contained in the belly.——The ſubſtance of the *oſſa ilium* is moſtly cellular, except a thin external table.

In a ripe child, the ſpine of the *os ilium* is cartilaginous, and is afterwards joined to the bone in form of an *epiphyſe*.——The large lower end of this bone is not compleatly oſſified.

*OS ISCHIUM** or *hip bone*, is of a middle bulk between the two other parts of the *os innominatum*, is ſituated loweſt of the three, and is of a very irregular figure.——Its extent

* Coxæ, coxendicis, pixis.

tent might be marked by an horizontal line drawn near through the middle of the *acetabulum*; for the upper bulbous part of this bone forms some less than the lower half of that great cavity, and the small leg of it rises to much the same height on the other side of the great hole common to this bone and the *os pubis*.

From the upper thick part of the *os ischium*, a sharp process, called by some *spinous*, stands out backwards, from which chiefly the *musculus coccygaeus* and *superior gemellus*, and part of the *levator ani*, rise; and the anterior or internal *sacrosciatic* ligament is fixed to it.——Between the upper part of this ligament and the bones, it was formerly observed that the *pyriform* muscle, the posterior crural vessels, and the sciatic nerve, pass out of the *pelvis*.—Immediately below this process, a sinuosity is formed for the tendon of the *musculus obturator internus*.—In a recent subject, this part of the bone, which serves as a pully on which the *obturator* muscle plays, is covered with a ligamentous cartilage, that, by two or three small ridges, points out the interstices of the fibres in the tendon of this muscle.———The outer surface of the bone at the root of this spinous process is made hollow by the *pyriformis* or *iliacus externus* muscle.

Below the sinuosity for the *obturator* muscle, is the great knob or *tuberosity*, covered with cartilage or tendon (*a*).——The upper part of the tuberosity gives rise to the inferior

(*a*) Winslow, Exposit. anat. des os frais, § 96.

inferior *gemellus* muſcle.——To a ridge at the inſide of this, the external or poſterior *ſocroſciatic* ligament, is ſo fixed that between it, the internal ligament, and the ſinuoſity of the *os iſchium*, a paſſage is left for the internal *obturator*, muſcle.———The upper thick ſmooth part of the *tuber*, called by ſome its *dorſum*, has two oblique impreſſions on it. The inner one gives origin to the long head of the *biceps flexor tibiæ* and *ſeminervoſus* muſcles, and the *ſemimembranoſus* riſes from the exterior one, which reaches higher and nearer the *acetabulum* than the other.——The lower, thinner, more ſcabrous part of the knob which bends forewards, is alſo marked with two flat ſurfaces, whereof the internal is what we lean upon in ſitting, and the external gives riſe to the largeſt head of the *triceps adductor femoris*.———Between the external margin of the tuberoſity and the great hole of the *os innominatum*, there is frequently an obtuſe ridge extended down from the *acetabulum*, which gives origin to the *quadratus femoris*. —As the *tuber* advances forewards, it becomes ſmaller, and is rough, for the origin of the *muſculus tranſverſalis* and *erector penis*.——— The ſmall leg of it, which mounts upwards to join the *os pubis*, is rough and prominent at its edge, where the two lower heads of the *triceps* or *quadriceps adductor femoris* take their riſe.

The upper and back part of the *os iſchium* is broad and thick; but its lower and fore-part is narrower and thinner.——Its ſubſtance is of the ſtructure common to broad bones.

The

The *os ilium* and *pubis* of the same side are the only bones which are contiguous to the *os ischium*.

The part of the *os ischium* which forms the *acetabulum*, the spinous process, the great *tuber*, and the recurved leg, are all cartilaginous at birth.——The *tuber*, with part of the leg or process above it, becomes an epiphyse before this bone is fully formed.

The *OS PUBIS**, or *share bone*, is the least of the three parts of the *os innominatum*, and is placed at the upper fore-part of it.——The thick largest part of this bone is employed in forming the *acetabulum*; from which becoming much smaller, it is stretched inwards to its fellow of the other side, where again it grows larger, and sends a small branch downwards to join the end of the small leg of the *os ischium*.——The upper fore-part of each *os pubis* is tuberous and rough where the *musculus rectus* and *pyramidalis* are inserted. ——From this a ridge is extended along the upper edge of the bone, in a continued line with such another of the *os ilium*, which divides the *abdomen* and *pelvis*. The ligament of *Fallopius* is fixed to the internal end of this ridge, and the smooth hollow below it is made by the *psoas* and *iliacus internus* muscles passing with the anterior crural vessels and nerves behind the ligament.——Some way below the former ridge, another is extended from the tuberous part of the *os pubis* downwards and outwards towards the *acetabulum*;

S between

* Ἥβης, pectinis, penis, pudibundum, fenestratum.

between these two ridges the bone is hollow and smooth, for lodging the head of the *pectineus* muscle.——Immediately below, where the lower ridge is to take the turn downwards, a winding nitch is made, which is comprehended in the great *foramen* of a skeleton, but is formed into a hole by a subtended ligament in the recent subject, for the passage of the posterior crural nerve, an artery, and a vein.——The internal end of the *os pubis* is rough and unequal, for the firmer adhesion of the thick ligamentous cartilage that connects it to its fellow of the other side: ——The process which goes down from that to the *os ischium* is broad and rough before, where the *gracilis* and upper heads of the *triceps*, or rather *quadriceps adductor femoris* have their origin.

The substance of the *os pubis* is the same as of other broad bones.

Only a part of the large end of this bone is ossified, and the whole leg is cartilaginous, in a child born at the full time.

Betwixt the *os ischium* and *pubis* a very large irregular hole is left, which, from its resemblance to a door or shield, has been called *thyroides*. This hole is all, except the nitch for the posterior crural nerve, filled up in a recent subject with a strong ligamentous membrane, that adheres very firmly to its circumference. From this membrane chiefly the two *obturator* muscles, external and internal, take their rise.——The great design of this hole, besides rendering the bone lighter, is to allow a strong enough origin to the *obturator*

tor muſcles, and ſufficient ſpace for lodging their bellies, that there may be no danger of diſturbing the functions of the contained *viſcera* of the *pelvis* by the actions of the internal, nor of the external being bruiſed by the thigh bone, eſpecially by its leſſer *trochanter*, in the motions of the thigh inwards: Both which inconveniences muſt have happened, had the *oſſa innominata* been compleat here, and of ſufficient thickneſs and ſtrength to ſerve as the fixed point of theſe muſcles.—— The bowels ſometimes make their way through the nich for the veſſels, at the upper part of this *thyroid* hole, and this cauſes a *hernia* in this place (*a*).

In the external ſurface of the *oſſa innominata*, near the outſide of the great hole, a large deep cavity is formed by all the three bones conjunctly: For the *os pubis* conſtitutes about one fifth; the *os ilium* makes ſomething leſs than two fifths, and the *os iſchium* as much more than two fifths. The brims of this cavity are very high, and are ſtill much more enlarged by the ligamentous cartilage, with which they are tipped in a recent ſubject. From this form of the cavity it has been called *acetabulum*; and for a diſtinguiſhing character, the name of the bone that conſtitutes the largeſt ſhare of it is added; therefore *acetabulum oſſis iſchii* * is the name this cavity commonly bears——Round the baſe

(*a*) Memoires de l'acad. de chirurgie, tom. 1. p. 709, &c.
* Coxæ, coxendicis.

of the *supercilia* the bone is rough and unequal, where the *capsular* ligament of the articulation is fixed.——The brims at the upper and back part of the *acetabulum* are much larger and higher than any where else; which is very necessary to prevent the head of the *femur* from slipping out of its cavity at this place, where the whole weight of the body bears upon it, and consequently would otherwise be constantly in danger of thrusting it out.——As these brims are extended downwards and forewards, they become less; and at their internal lower part a breach is made in them; from the one side of which to the other, a ligament is placed in the recent subject; under which a large hole is left, which contains a fatty cellular substance and vessels. The reason of which appearance has afforded matter of debate. To me it seems evidently contrived for allowing a larger motion to the thigh inwards: For if the bony brims had been here continued, the neck of the thigh-bone must have struck upon them when the thighs were brought across each other; which, in a large strong motion this way, would have endangered the neck of the one bone, or brim of the other. Then the vessels which are distributed to the joint may safely enter at the sinuosity in the bottom of the breach; which being however larger than is necessary for that purpose, allows the large mucilaginous gland of the joint to escape below the ligament, when the head of the thigh bone is in hazard of pressing too much upon it in the motions

motions of the thigh outwards (*a*).——Beſides this difference in the height of the brims, the *acetabulum* is otherwiſe unequal: For the lower internal part of it is depreſſed below the cartilaginous ſurface of the upper-part, and is not covered with cartilage; into the upper-part of this particular depreſſion, where it is deepeſt and of a ſemilunar form, the ligament of the thigh-bone, commonly, though improperly, called the *round* one, is inſerted; while in its more ſuperficial lower part the large mucilaginous gland of this joint is lodged. The largeſt ſhare of this ſeparate depreſſion is formed in the *os iſchium*.

From what has been ſaid of the condition of the three bones compoſing this *acetabulum* in new born children, it muſt be evident, that a conſiderable part of this cavity is cartilaginous in them.

The *oſſa innominata* are joined at their back part to each ſide of the *os ſacrum* by a ſort of ſuture, with a very thin interveening cartilage, which ſerves as ſo much glue to cement theſe bones together; and ſtrong ligaments go from the circumference of this unequal ſurface, to connect them more firmly. The *oſſa innominata* are connected together at their fore-part by the ligamentous cartilage interpoſed between the two *oſſa pubis*.—Theſe bones can therefore have no motion in a natural ſtate, except what is common to the trunk of the body, or to the *os ſacrum*. But it has been diſputed, whether or not they looſen ſo much from each other, and from the *os ſacrum*, in child-birth, by the

(*a*) Petit, Memoires de l'acad. des ſciences, 1722.

flow of *mucus* to the *pelvis*, and by the throws of the labour, as that the *ossa pubis* recede from each other, and thereby allow the passage between the bones to be enlarged.—Several observations (*a*) shew that this relaxation sometimes happens: But those who had frequently opportunities of dissecting the bodies of women who died immediately after being delivered of children, teach us to beware of regarding this as the common effect of child-birth; for they found such a relaxation in very few of the bodies which they examined (*b*).

Considering what great weight is supported in our erect posture, by the articulation of the *ossa innominata* with the *os sacrum*, there is great reason to think that if the conglutinated surfaces of these bones were once separated, (without which, the *ossa pubis* cannot shuffle on each other), the ligaments would be violently stretched, if not torn; from whence many disorders would arise (*c*).

Each *os innominatum* affords a socket (the *acetabulum*) for the thigh-bones to move in, and the trunk of the body rolls here so much on the heads of the thigh-bones, as to allow the most conspicuous motions of the *trunk*, which are commonly thought to be performed by the bones

(*a*) Bauhin. Theat. anat. lib. 1. cap. 49.——Spigel. Anat. lib. 2. cap. 24.——Riolan. Anthropogr. lib. 6. cap. 12.——Diemerbroeck, Anat. lib. 9. cap. 16.

(*b*) Hildan. Epist. cent. obs. 46.—Dionis Sixieme demonst. des os.——Morgagn. Advers. 3. animad. 15.

(*c*) Ludov. in Ephem. German. dec. 1. ann. 3. obs. 255.

bones of the ſpine.——This articulation is to be more fully deſcribed after the *oſſa femoris* are examined.

The *pelvis* then has a large open above where it is continued with the *abdomen*, is ſtrongly fenced by bones on the ſides, back, and fore-part, and appears with a wide opening below, in the ſkeleton; but, in the recent ſubject, a conſiderable part of the opening is filled by the *ſarcroſciatic* ligaments, *pyriform*, *internal obturator*, *levatores ani*, *gemini*, and *coccygæi* muſcles, which ſuppport and protect the contained parts better than bones could have done; ſo that ſpace is only left at the loweſt part of it, for the large excretories, the *veſica urinaria*, *inteſtinum rectum*, and in females, the *uterus*, to diſcharge themſelves.

The *THORAX**, or *cheſt*, which is the only part of the trunk of the body which we have not yet deſcribed, reaches from below the neck to the belly; and, by means of the bones that guard it, is formed into a large cavity; The figure of which is ſomewhat conoidal; but its upper ſmaller end is not finiſhed, being left open for the paſſage of the wind-pipe, gullet, and large blood-veſſels; and its lower part, or baſe, has no bones, and is ſhorter before than behind; ſo that, to carry on our compariſon, it appears like an oblique ſection of the conoid. Beſides which we ought alſo to remark, that the lower part of this cavity is narrower than ſome way

* Pectus, caſſum.

way above (*a*); and that the middle of its back-part is conſiderably diminiſhed by the bones ſtanding forewards into it.

The bones which form the *thorax* are the twelve dorſal *vertebræ* behind, the ribs on the ſides, and the *ſternum* before.

The *vertebræ* have already been deſcribed as part of the ſpine; and therefore are now to be paſſed.

The *RIBS*, or *coſtæ* *, (as if they were *cuſtodes*, or guards, to theſe principal organs of the animal machine, the heart and lungs), are the long crooked bones placed at the ſide of the cheſt, in an oblique direction downwards in reſpect of the back-bone.——Their number is generally twelve on each ſide; though frequently eleven or thirteen have been found (*b*).—Sometimes the ribs are found preternaturally conjoined or divided (*c*).

The ribs are all concave internally; where they are alſo made ſmooth by the action of the contained parts, which, on this account, are in no danger of being hurt by them; and they are convex externally, that they might reſiſt that part of the preſſure of the atmoſphere, which is not ballanced by the air within the lungs, during *inſpiration*.——The ends of the ribs next the *vertebræ* are rounder than they are after theſe bones have advanced forewards, when they become flatter and broader, and have an

(*a*) Albin. de oſſib. § 169.

* Πλευραι, περιςέρνα, στηθη.

(*b*) Riolan. Comment. de oſſibus, cap. 19.—Marchetti. cap. 9. Cowper Explicat. tab. 93. and 94.—Morgagn. Adverſ. anat.

(*c*) Sue Trad. d'oſteol. p. 141.

an upper and lower edge, each of which is made rough by the action of the *intercoſtal* muſcles, inſerted into them. Theſe muſcles, being all of nearly equal force, and equally ſtretched in the interſtices of the ribs, prevent the broken ends of theſe bones in a fracture from being removed far out of their natural place, to interrupt the motion of the vital organs.—The upper edge of the ribs is more obtuſe and rounder than the lower, which is depreſſed on its internal ſide by a long *foſſa*, for lodging the intercoſtal veſſels and nerves; on each ſide of which there is a ridge, to which the intercoſtal muſcles are fixed. The *foſſa* is not obſervable however at either end of the ribs; for at the poſterior or root, the veſſels have not yet reached the ribs; and, at the fore-end, they are ſplit away into branches, to ſerve the parts between the ribs: Which plainly teaches ſurgeons one reaſon of the greater ſafety of performing the operation of the *empyema* towards the ſides of the *thorax*, than either near the back or the breaſt.

At the poſterior end * of each *rib*, a little head is formed, which is divided by a middle ridge into two plain or hollow ſurfaces; the loweſt of which is the broadeſt and deepeſt in moſt of them. The two plains are joined to the bodies of two different *vertebræ*, and the ridge forces itſelf into the interveening cartilage.——A little way from this head, we find, on the external ſurface, a ſmall cavity, where mucilaginous glands are lodged; and round the head, the bone appears ſpongy, where the capſular

* Κώπιον, remulus.

ſular ligament of the articulation is fixed.—— Immediately beyond this a flatted tubercle riſes, with a ſmall cavity at, and roughneſs about its root, for the articulation of the rib with the tranſverſe proceſs of the loweſt of the two *vertebræ*, with the bodies of which the head of the rib is joined.—Advancing further on this external ſurface, we obſerve in moſt of the ribs another ſmaller tubercle, into which ligaments which connect the ribs to each other, and to the tranſverſe proceſſes of the *vertebræ* and portions of the *longiſſimus dorſi*, are inſerted.—— Beyond this the ribs are made flat by the *ſacro-lumbalis* muſcle, which is inſerted into the part of this flat ſurface fartheſt from the ſpine, where each rib makes a conſiderable curve, called by ſome its *angle*.——Then the rib begins to turn broad, and continues ſo to its anterior end *, which is hollow and ſpongy, for the reception of and firm coalition with the cartilage that runs thence to be inſerted into the *ſternum*, or to be joined with ſome other cartilage.—In adults, generally the cavity at this end of the ribs is ſmooth and poliſhed on its ſurface; by which the articulation of the cartilage with it has the appearance of being deſigned for motion: but it has none.

The ſubſtance of the ribs is ſpongy, cellular, and only covered with a very thin external lamellated ſurface, which increaſes in thickneſs and ſtrength as it approaches the *vertebræ*.

To the fore-end of each rib a long broad and ſtrong cartilage is fixed, and reaches thence to

* Πλατη, palmula

to the *ſternum*, or is joined to the cartilage of the next rib. This courſe, however, is not in a ſtreight line with the rib; for generally the cartilages make a conſiderable curve, the concave part of which is upwards; therefore, at their inſertion into the *ſternum*, they make an obtuſe angle above, and an acute one below.—Theſe cartilages are of ſuch a length as never to allow the ribs to come to a right angle with the ſpine; but they keep them ſituated ſo obliquely, as to make an angle very conſiderably obtuſe above, till a force exceeding the elaſticity of the cartilages is applied.—Theſe cartilages, as all others, are firmer and harder internally, than they are on their external ſurface; and ſometimes, in old people, all their middle ſubſtance becomes bony, while a thin cartilaginous *lamella* appears externally (*a*). The oſſification however begins frequently at the external ſurface.——The greateſt alternate motions of the cartilages being made at their great curvature, that part remains frequently cartilaginous, after all the reſt is oſſified (*b*).

The ribs then are articulated at each end, of which the one behind is doubly joined to the *vertebræ*; for the head is received into the cavities of two bodies of the *vertebræ*, and the larger tubercle is received into the depreſſion in the tranſverſe proceſs of the lower *vertebra*. ———When one examines the double articulation, he muſt immediately ſee, that no other motion can here be allowed than upwards and downwards; ſince the tranſverſe proceſs hinders the

(*a*) Veſal. lib. 2. cap. 19.
(*b*) Havers. Oſteolog. nov. diſc. 5. p. 289.

the rib to be thruſt back; the reſiſtance on the other ſide of the *ſternum* prevents the ribs coming foreward; and each of the two joints, with the other parts attached, oppoſe its turning round. But then it is likewiſe as evident, that even the motion upwards and downwards can be but ſmall in any one rib at the articulation itſelf. But as the ribs advance forewards, the diſtance from their center of motion increaſing, the motion muſt be larger; and it would be very conſpicuous at their anterior ends, were not they reſiſted there by the cartilages, which yield ſo little, that the principal motion is performed by the middle part of the ribs, which turns outwards and upwards, and occaſions the twiſt remarkable in the long ribs at the place near their fore-end where they are moſt reſiſted (*a*).

Hitherto I have laid down the ſtructure and connection which moſt of the ribs enjoy, as belonging to all of them; but muſt now conſider the ſpecialities wherein any of them differ from the general deſcription given, or from each other.

In viewing the ribs from above downwards, their figure is ſtill ſtreighter; the uppermoſt being the moſt crooked of any.—Their obliquity in reſpect of the ſpine increaſes as they deſcend; ſo that though their diſtances from each other is very little different at their back part, yet at their fore ends the diſtances between the lower ones muſt increaſe.—In conſequence too of this increaſed obliquity of the lower ribs, each

(*a*) Winſlow. Memoires de l'acad. des ſciences, 1720.

each of their cartilages makes a greater curve in its progress from the rib towards the *sternum;* and the tubercles, that are articulated to the transverse processes of the *vertebræ*, have their smooth surfaces gradually facing more upwards.——The ribs becoming thus more oblique, while the *sternum* advances forewards in its descent, makes the distance between the *sternum* and the anterior end of the lower ribs greater than between the *sternum* and the ribs above; consequently the cartilages of those ribs that are joined to the breast-bone are longer in the lower than in the higher ones.—These cartilages are placed nearer to each other as the ribs descend, which occasions the curvature of the cartilages to be greater.

The length of the ribs increases from the first and uppermost rib, as far down as the seventh; and from that to the twelfth, as gradually diminishes.——The superior of the two plain, or rather hollow surfaces, by which the ribs are articulated to the bodies of the *vertebræ*, gradually increases from the first to the fourth rib, and is diminished after that in each lower rib.———The distance of their angles from the heads always increases as they descend to the ninth, because of the greater breadth of the *sacrolumbalis* muscle (*a*).

The ribs are commonly divided into *true* and *false*.

The *true* † *costae* are the seven upper ones of each side, whose cartilages are all gradually

T

(*a*) Winslow. Exposition anatomique des os secs, § 643.

† Γνήσιαι, Germanæ, legitimæ.

dually longer as the ribs descend, and are joined to the breast-bone; so that being pressed constantly between two bones, they are flatted at both ends, and are thicker, harder, and more liable to ossify, than the other cartilages, that are not subject to so much pressure. These ribs include the heart and lungs; and therefore are the proper or true *custodes* of life.

The five inferior ribs of each side are the *false* or *BASTARD* *, whose cartilages do not reach to the *sternum*; and therefore, wanting the resistance at their fore-part, they are there pointed; and, on this account, having less pressure, their substance is softer. ——The cartilages of these *false ribs* are shorter as the ribs descend.——To all these five ribs the circular edge of the *diaphragm* is connected; and its fibres, instead of being stretched immediately transversely, and so running perpendicular to the ribs, are pressed so as to be often, especially in exspiration, parallel to the plane in which the ribs lie: Nay, one may judge by the attachments which these fibres have so frequently to the sides of the *thorax*, a considerable way above where their extremities are inserted into the ribs, and by the situation of the *viscera*, always to be observed in a dead subject laid supine, that there is constantly a large concavity formed on each side by the *diaphragm* within these bastard ribs, in which the stomach, liver, spleen, *&c.* are contained; which, being only reckoned

* Μαλθακαι, χονδροδεις, ἀκανθαι, νοθαι, ῥοαι, adulterinæ, spuriæ, illegitimæ.

reckoned among the *viscera naturalia*, have occasioned the name of *bastard custodes* to these bones.

Hence in simple fractures of the false ribs, without fever, the stomach ought to be kept moderately filled with food, lest the pendulous ribs falling inwards, should thereby increase the pain, cough, &c. (*a*).——Hence likewise we may learn how to judge better of the seat of several diseases, and to do the operation of the *empyema*, and some others, with more safety than we can do, if we follow the common directions.

The eight upper ribs were formerly (*b*) classed into pairs, with particular names to each two, to wit, the *crooked*, the *solid*, the *pectoral*, the *twisted*: But these names are of so little use, that they are now generally neglected.

The *first* rib of each side is so situated, that the flat sides are above and below, while one edge is placed inwards, and the other outwards, or nearly so; therefore sufficient space is left above it for the subclavian vessels and muscle; and the broad concave surface is opposed to the lungs: But then, in consequence of this situation, the channel for the intercostal vessels is not to be found, and the edges are differently formed from all the other, except the second; the lower one being rounded, and the other sharp.——The head of this rib is not divided into two plain surfaces by

(*a*) Hippocrat. de articulo, § 51.—Pare, lib. 15. cap. 11.
(*b*) Laurent. Hist. anat. lib. 2. cap. 29.——Paaw, de ossibus, part. 3. cap. 2.

a middle ridge, because it is only articulated with the first *vertebra* of the *thorax*.——Its cartilage is ossified in adults, and is united to the *sternum* at right angles.——Frequently this first rib has a ridge rising near the middle of its posterior edge, where one of the heads of the *scalenus* muscle rises.———Farther forward it is flatted, or sometimes depressed by the clavicle.

The fifth, sixth, and seventh, or rather the sixth, seventh, eight, and sometimes the fifth, sixth, seventh, eight, ninth ribs, have their cartilages at least contiguous; and frequently they are joined to each other by cross cartilages; and most commonly the cartilages of the eight, ninth, tenth, are connected to the former and to each other by firm ligaments.

The *eleventh*, and sometimes the *tenth* rib, has no tubercle for its articulation with the transverse process of the *vertebra*, to which it is only loosely fixed by ligaments.——The *fossa* in its lower edge is not so deep as in the upper ribs, because the vessels run more towards the interstice between the ribs.—Its fore-end is smaller than its body, and its short small cartilage is but loosely connected to the cartilage of the rib above.

The *twelfth* rib is the shortest and straightest.———Its head is only articulated with the last *vertebra* of the *thorax*; therefore is not divided into two surfaces.——This rib is not joined to the transverse process of the *vertebra*, and therefore has no tubercle, being often

ten pulled neceſſarily inwards by the diaphragm, which an articulation with the tranſverſe proceſs would not have allowed.——The *foſſa* is not found at its under edge, becauſe the veſſels run below it.——The fore part of this rib is ſmaller than its middle, and has only a very ſmall pointed cartilage fixed to it.——To its whole internal ſide the diaphragm is connected.

The motions and uſes of the ribs ſhall be more particularly treated of, after the deſcription of the *ſternum*.

The heads and tubercles of the ribs of a new born child have cartilages on them; part of which becomes afterwards thin epiphyſes.——The bodies of the ribs incroach gradually after birth upon the cartilages; ſo that the latter are proportionally ſhorter, when compared to the ribs, in adults, than in children.

Here I cannot help remarking the wiſe providence of our Creator, in preſerving us from periſhing as ſoon as we come into the world. The end of the bones of the limbs remain in a cartilaginous ſtate after birth, and are many years before they are entirely united to the main body of their ſeveral bones; whereas the condyles of the occipital bone, and of the lower jaw, are true original proceſſes, and oſſified before birth, and the heads and tubercles of the ribs are nearly in the ſame condition; and therefore the weight of the large head is firmly ſupported; the actions of ſucking, ſwallowing, reſpiration, *&c.* which are indiſpenſably neceſſary for us as ſoon as we

come into the world, are performed without danger of separating the parts of the bones that are most pressed on in these motions: Whereas, had these processes of the head, jaw, and ribs, been epiphyses at birth, children must have been exposed to danger of dying by such a separation; the immediate consequences of which would be the compression of the beginning of the *spinal* marrow, or want of food, or a stop put to respiration.

The *STERNUM**, or *breast-bone*, is the broad flat bone, or pile of bones, at the fore-part of the *thorax*.———The number of bones which this should be divided into, has occasioned debates among anatomists, who have considered it in subjects of different ages.———In adults of a middle age, it is composed of three bones, which easily separate after the cartilages connecting them are destroyed. Frequently the two lower bones are found intimately united; and very often in old people, the *sternum* is a continued bony substance from one end to the other; though we still observe two, sometimes three transverse lines on its surface; which are marks of the former divisions

When we consider the *sternum* as one bone, we find it broadest and thickest above, and becoming smaller as it descends. The internal surface of this bone is somewhat hollowed for enlarging the *thorax*; but the convexity on the external surface is not so conspicuous, because the sides are pressed outwards by.

* Σήθος, os pectoris, ensiforme, scutum cordis

by the true ribs; the round heads of whose cartilages are received into seven smooth pits, formed on each side of the *sternum*, and are kept firm there by strong ligaments, which on the external surface have a particular radiated texture (*a*).—Frequently the cartilaginous fibres thrust themselves into the bony substance of the *sternum*, and are joined by a sort of future — The pits at the upper part of the *sternum* are at the greatest distance one from another, and, as they descend, are nearer; so that the two lowest are contiguous.

The substance of the breast-bone is cellular, with a very thin external plate, especially on its internal surface, where we may frequently observe a cartilaginous crust spread over it (*b*). On both surfaces, however, a strong ligamentous membrane is closely braced; and the cells of this bone are so small that a considerable quantity of osseous fibres must be employed in the composition of it: Whence, with the defence which the muscles give it, and the moveable support it has from the cartilages, it is sufficiently secured from being broken; for it is strong by its quantity of bone; its parts are kept together by ligaments; and it yields enough to elude considerably the violence offered (*c*).

So far may be said of this bone in general; but the three bones, of which, according to the

(*a*) Ruysch. Catalog. rar fig. 9.
(*b*) Jac. Sylv. in Galen de ossibus, cap. 12.
(*c*) Senac. in Memoires de l'acad, des sciences, 1724.

the common account, it is composed in adults, are each to be examined.

The *first*, all agree, is somewhat of the figure of a heart, as it is commonly painted; only it does not terminate in a sharp point.—This is the uppermost thickest part of the *sternum*.

The upper middle part of this first bone, where it is thickest, is hollowed, to make place for the *trachea arteria*; though this cavity * is principally formed by the bone being raised on each side of it, partly by the clavicles thrusting it inwards, and partly by the *sterno mastoidei* muscles pulling it upwards.——On the outside of each tubercle, there is an oblong cavity, that in viewing it transversely from before backwards, appears a little convex: Into these *glenæ*, the ends of the clavicles are received.—Immediately below these, the sides of this bone begin to turn thinner; and in each a superficial cavity or a rough surface is to be seen, where the first ribs are received or joined to the *sternum*.——In the side of the under end of this first bone, the half of the pit for the second rib on each side is formed.——The upper part of the surface behind is covered with a strong ligament, which secures the clavicles; and is afterwards to be more particularly taken notice of.

The second or middle division of this bone, is much longer, narrower, and thinner, than the first; but, excepting that it is a little narrower

* Σφαγή, jugulum, furcula superior.

rower above than below, it is nearly equal all over in its dimenſions of breadth or thickneſs.——In the ſides of it are compleat pits for the third, fourth, fifth, and ſixth ribs, and an half of the pits for the ſecond and ſeventh. The lines, which are marks of the former diviſion of this bone, being extended from the middle of the pits of one ſide to the middle of the correſponding pits of the other ſide.—— Near its middle an unoſſified part of the bone is ſometimes found, which, freed of the ligamentous membrane or cartilage that fills it, is deſcribed as a hole; and in this place, for the moſt part, we may obſerve a tranſverſe line, which has made authors divide this bone into two.—When the cartilage between this and the firſt bone is not oſſified, a manifeſt motion of this upon the firſt may be obſerved in reſpiration or in raiſing the *ſternum*, by pulling the ribs upwards or diſtending the lungs with air in a recent ſubject.

The third bone is much leſs than the other two, and has only one half of the pit for the ſeventh rib formed in it; wherefore it might be reckoned only an *appendix* of the *ſternum*. ——In young ſubjects it is always cartilaginous, and is better known by the name of *cartilago xiphoides* or *enſiformis* *, than any other; though the ancients often called the whole *ſternum*, *enſiforme*, comparing the two firſt bones to the handle

* Clypealis, gladialis, mucronata, malum granatum, ſcutum ſtomachi, epiglottalis, cultralis, medium furculæ inferioris, ſcutiformis, enſiculata.

handle and this *appendix* to the blade of a ſword.—This third bone is ſeldom of the ſame figure, magnitude, or ſituation in any two ſubjects; for ſometimes it is a plain triangular bone, with one of the angles below, and perpendicular to the middle of the upper ſide, by which it is connected to the ſecond bone.——In other people the point is turned to one ſide or obliquely forewards or backwards.—Frequently it is all nearly of an equal breadth, and in ſeveral ſubjects it is bifurcated; whence ſome writers give it the name of *furcella* or *furcula inferior*; or elſe it is unoſſified, in the middle.—— In the greateſt number of adults it is oſſified, and tipped with a cartilage; in ſome one half of it is cartilaginous, and in others it is all in a cartilaginous ſtate.—Generally ſeveral oblique ligaments fixed at one end to the cartilages of the ribs, and by the other to the outer ſurface of the *xiphoid* bone, connect it firmly to thoſe cartilages (*a*).

So many different ways this ſmall bone may be formed, without any inconvenience: But then ſome of theſe poſitions may be ſo directed, as to bring on a great train of ill conſequences; particularly, when the lower end is oſſified, and is too much turned outwards or inwards (*b*), or when the conjunction

(*a*) Weitbrecht, Syndeſmolog. p. 121.

(*b*) Rolfinc. Differt. anat. lib. 2. cap. 41.——Paaw de oſſib. part 1. cap. 3. & part 3. cap. 3.--Codronchi de prolapſu cartilagin. mucronat.

tion of this *appendix* with the ſecond bone is too weak (*a*).

The *ſternum* is joined by cartilages to the ſeven upper ribs, unleſs when the firſt coaleſces with it in an intimate union of ſubſtance: and its unequal cavity on each ſide of its upper end is fitted for the ends of the clavicles.

The *ſternum* moſt frequently has four round ſmall bones, ſurrounded with cartilage, in children born at the full time; the uppermoſt of theſe, which is the firſt bone, being the largeſt.——Two or three other very ſmall bony points are likewiſe to be ſeen in ſeveral children.——The number of bones increaſes for ſome years, and then diminiſhes, but uncertainly, till they are at laſt united into thoſe above deſcribed of an adult.

The uſes of this bone are, to afford origin and inſertion to ſeveral muſcles; to ſuſtain the *mediaſtinum*, to defend the vital organs, the heart and lungs, at the fore-part; and, laſtly, by ſerving as a moveable *fulcrum* of the ribs, to aſſiſt conſiderably in reſpiration: Which action, ſo far it depends on the motion of the bones, we are now at liberty to explain.

When the ribs that are connected by their cartilages to the *ſternum*, or to the cartilages of the true ribs, are acted upon by the intercoſtal muſcles, they muſt all be pulled from the oblique

(*a*) Paaw. ibid.—Bortich. act. Hafn. vol. 5. ob. 79.—Bonet. Sepulchret. anat. tom. 2. lib. 3. § 5. Append. ad obſ. 8. et. ibid. § 7. obſ. 19.

oblique position which their cartilages kept them in, nearer to right angles with the *vertebræ* and *sternum*, because the first or uppermost rib is by much the most fixed of any; and the cartilages making a great resistance to raising the anterior ends of the ribs, their large arched middle parts turn outwards as well as upwards.——The *sternum*, pressed strongly on both sides by the cartilages of the ribs, is pushed forewards, and that at its several parts, in proportion to the length and motion of its supporters, the ribs; that is, most at its lower end.——The *sternum* and the cartilages, thus raised forewards, must draw the *diaphragm* connected to them; consequently so far stretch it, and bring it nearer to a plane.——The power that raises this bone and the cartilages, fixes them sufficiently to make them resist the action of the *diaphragm*, whose fibres contract at the same time, and thrust the *viscera* of the *abdomen* downwards.——The arched part of the ribs being thus moved outwards, their anterior ends and the *sternum* being advanced forewards, and the diaphragm being brought nearer to a plain surface, instead of being greatly convex on each side within each cavity of the *thorax*, it is evident how considerably the cavity, of which the nine or ten upper ribs are the sides, must be widened, and made deeper and longer.——While this is doing in the upper ribs, the lower ones, whose cartilages are not joined to the *sternum* or to other cartilages, move very differently, though they conspire to the same intention, the enlargement of the *thorax*: For having no fixed point to which their anterior

anterior ends are faſtened, and the *diaphragm* being inſerted into them at the place where it runs pretty ſtreight upwards from its origin at the *vertebræ*, theſe ribs are drawn downwards by this ſtrong muſcle, and by the muſcles of the *abdomen*, which, at this time, are reſiſting the ſtretching force of the bowels; while the intercoſtal muſcles are pulling them in the contrary direction, to wit, upwards: The effect therefore of either of theſe powers, which are antagoniſts to each other, is very little, as to moving the ribs either up or down; but the muſcles of the *abdomen*, puſhed at this time outwards by the *viſcera*, carry theſe ribs along with them.——Thus the *thorax* is not only not allowed to be ſhortened, but is really widened at its lower part, to aſſiſt in making ſufficient ſpace for the due diſtenſion of the lungs.

As ſoon as the action of theſe ſeveral muſcles ceaſes, the elaſtic cartilages extending themſelves to their natural ſituation, depreſs the upper ribs, and the *ſternum* ſubſides;—— the diaphragm is thruſt up by the *viſcera abdominalia*, and the oblique and tranſverſe muſcles of the belly ſerve to draw the inferior ribs inwards at the ſame time.——By theſe cauſes, the cavity of the breaſt is diminiſhed in all its dimenſions.

Though the motions above deſcribed of the ribs and *ſternum*, eſpecially of the latter bone, are ſo ſmall in the mild reſpiration of a healthy perſon, that we can ſcarce obſerve them; yet they are manifeſt whenever we deſignedly increaſe our reſpiration, or are obliged to do it after exerciſe, and in ſeveral diſeaſes.

OF THE SUPERIOR EXTREMITIES.

AUthors are much divided in their opinions about the number of bones which each *ſuperior extremity* * ſhould be ſaid to conſiſt of, ſome deſcribing the *clavicle* and *ſcapula* as part of it, others claſſing theſe two bones with thoſe of the *thorax*: But ſince moſt quadrupeds have no *clavicles*, and the human *thorax* can perform its functions right when the *ſcapula* is taken away (*a*), whereas it is impoſſible for us to have the right uſe of our arms without theſe bones; I muſt think that they belong to the *ſuperior extremities*; and therefore ſhall divide each of them into the *ſhoulder*, *arm*, *fore-arm*, and *hand*.

The *SHOULDER* conſiſts of the *clavicle* and *ſcapula*.

CLAVICULA, or *collar-bone* †, is the long crooked bone, in figure like an *Italic f*, placed almoſt horizontally between the upper lateral part of the *ſternum*, and what is commonly called the top of the ſhoulder, which, as a *clavis* or beam, it bears off from the trunk of the body.

The *clavicle*, as well as other long round bones, is larger at its two ends, than in the middle. The end next to the *ſternum* ‡ is triangular:

* Κωλα, γυια, ἐπφυαδες, Enata, adnata, explantata membra, artus.

(*a*) Philoſoph. tranſact. numb. 449. § 5.

† Os jugulare, jugulum, furcula, ligula, clavis, humerus quibuſdam.

‡ Παραστφαγις.

triangular: The angle behind is conſiderably produced, to form a ſharp ridge, to which the tranſverſe ligament extended from one clavicle to the other is fixed (*a*).—The ſide oppoſite to this is ſomewhat rounded.—The middle of this protuberant end is as irregularly hollowed, as the cavity in the *ſternum* for receiving it is raiſed; but in a recent ſubject, the irregular concavities of both are ſupplied by a moveable cartilage, which is not only much more cloſely connected every where by ligaments to the circumference of the articulation, than thoſe of the lower jaw are; but it grows to the two bones at both its internal and external end; its ſubſtance at the internal end being ſoft, but very ſtrong, and reſembling the intervertebral cartilages (*b*).

From this internal end, the *clavicle*, for about two fifths of its length, is bended obliquely forewards and downwards. On the upper and fore-part of this curvature a ſmall ridge is ſeen, with a plain rough ſurface before it; whence the *muſculus ſterno-hyoideus* and *ſterno-maſtoideus* have in part their origin.——Near the lower angle a ſmall plain ſurface is often to be remarked, where the firſt rib and this bone are contiguous (*c*), and are connected by a firm ligament (*d*).—From this a rough plain ſurface is extended outwards, where the pecto-

(*a*) Riolan. Encheirid. anat. lib. 6. cap. 13.——Winſlow, Expoſ. anat. des os frais, § 248.—Weitbrecht, Act. Petropolit. tom. 4. p. 255. et Syndeſmolog. ſect. 2. I. § 3.
(*b*) Weitbrecht, Syndeſmolog. ſect. 2. I. § 6.
(*c*) Dionis, Sixieme demonſt. des os.
(*d*) Weitbrecht, Syndeſmolog. ſect. 2. I. § 7.

ral muſcle has part of its origin.——Behind, the bone is made flat and rough by the inſertion of the larger ſhare of the ſubclavian muſcle.——After the clavicle begins to be bended backwards, it is round, but ſoon after becomes broad and thin; which ſhape it retains to its external end.——Along the external concavity, a rough ſinuoſity runs, from which ſome part of the deltoid muſcle takes its riſe: ——Oppoſite to this, on the convex edge, a ſcabrous ridge gives inſertion to a ſhare of the *cucullaris* muſcle. The upper ſurface of the clavicle here is flat; but the lower is hollow, for lodging the beginning of the *muſculus ſubclavius*; and towards its back-part a tubercle riſes, to which, and a roughneſs near it, the ſtrong ſhort thick ligament connecting this bone to the *coracoid* proceſs of the *ſcapula* is fixed.

The external end * of this bone is horizontally oblong, ſmooth, ſloping at the poſterior ſide, and tipped in a recent ſubject with a cartilage, for its articulation with the *acromion ſcapulæ*.——Round this the bone is ſpongy, for the firmer connection of the ligaments.

The medullary arteries, having their direction obliquely outwards, enter the clavicles by one or more ſmall paſſages in the middle of their back part.

The ſubſtance of this bone is the ſame as of the other round long bones.

The triangular unequal interior end of each *clavicle*, has the cartilage above deſcribed interpoſed betwixt it and the irregular cavity of the *ſternum*.——The ligaments, which

* Ἔπωμις.

which ſurround this articulation to ſecure it, are ſo ſhort and ſtrong, that little motion can be allowed any way; and the ſtrong ligament that is ſtretched acroſs the upper *furcula* of the *ſternum*, from the poſterior prominent angle of the one clavicle, to the ſame place of the other clavicle, ſerves to keep each of theſe bones more firmly in their place. ——By the aſſiſtance, however, of the moveable interveening cartilage, the clavicle can, at this joint, be raiſed or depreſſed, and moved backwards and forewards ſo much, as that the external end, which is at a great diſtance from that axis, enjoys very conſpicuous motions.—The articulation of the exterior end of the clavicle ſhall be conſidered after the deſcription of the *ſcapula*.

The clavicles of infants are not deficient in any of their parts; nor have they any epiphyſes at their extremities joined afterwards to their bodies, as moſt other ſuch long bones have, which preſerves them from being bended too much, and from the danger of any unoſſified parts being ſeparated by the force which pulls the arms forewards.

The uſes of the clavicles are, to keep the *ſcapulæ*, and conſequently all the *ſuperior extremities*, from falling in and foreward upon the *thorax*; by which, as in moſt quadrupeds, the motions of the arms would be much confined, and the breaſt made too narrow.—The clavicles likewiſe afford origin to ſeveral muſcles, and a defence to large veſſels.

From the ſituation, figure, and uſe of the clavicles, it is evident that they are much ex-

posed to fractures; that their broken parts must generally go by each other; and that they are difficultly kept in their place afterwards.

SCAPULA, or *shoulder blade* *, is the triangular bone situated on the out-side of the ribs, with its longest side called its *base*, towards the spinal processes of the *vertebræ*, and with the angle at the upper part of this side about three inches, and the lower angle at a greater distance from these processes.—The back part of the *scapula* has nothing but the thin ends of the *serratus anticus major* and *subscapularis* muscles between it and the ribs: But as this bone advances forewards, its distance from the ribs increases.—The upper or shortest side, called the *superior costa* of the *scapula* is nearly horizontal, and parallel with the second rib.——The lower side, which is named the *inferior costa*, is extended obliquely from the third to the eighth rib.—The situation of this bone here described, is when people are sitting or standing in a state of inactivity, and allowing the members to remain in the most natural easy posture.——The inferior angle of the *scapula* is very acute; the upper one is near to a right angle; and what is called the anterior, does not deserve the name, for the two sides do not meet to form an angle. ——The body of this bone is concave towards the ribs, and convex behind, where it has the name of *dorsum* †.——Three processes are generally

* Ὠμοπλατος, επινωτιον, latitudo humeri, scoptulum vel scutulum opertum, spatula, ala, humerus, clypeus, scutum thoracis.

† Χελυνιον.

nerally reckoned to proceed from the *scapula*. —— The first is the large spine that rises from its convex surface behind, and divides it unequally.——The second process stands out from the fore part of the upper side; and, from its imaginary resemblance to a crow's beak, is named *coracoides* *.——The third process is the whole thick bulbous fore-part of the bone.

After thus naming the several constituent parts of the *scapula*, the particular description will be more easily understood.

The *base*, which is tipped with cartilage in a young subject, is not all streight: For above the spine, it runs obliquely forewards to the superior angle; that here it might not be too protuberant backwards, and so bruise the muscles and teguments: Into the oblique space the *musculus patientiæ* is inserted.——At the root of the spine, on the back part of the base, a triangular plain surface is formed, by the pressure of the lower fibres of the *trapezius*.—— Below this the edge of the *scapula* is scabrous and rough, for the insertion of the *serratus major anticus* and *rhomboid* muscles.

The back-part of the inferior angle is made smooth by the *latissimus dorsi* passing over it. This muscle also alters the direction of the *inferior costa* some way forewards from this angle: and so far it is flatted behind by the origin of the *teres major*.——As the *inferior costa* advances foreward, it is of considerable thickness, is slightly hollowed and made smooth behind by the *teres minor*, while it has a *fossa* formed into

* Anchoroides, sigmoides, digitalis, anciftroides.

into it below by part of the *subscapularis*; and between the two a ridge with a small depression appears, where the *longus extensor cubiti* has its origin.

The *superior costa* is very thin; and near its fore-part there is a semilunar nitch, from one end of which to the other a ligament is stretched; and sometimes the bone is continued, to form one, or sometimes two holes for the passage of the scapular blood-vessels and nerves.——Immediately behind this *semilunar* cavity the *coraco hyoid* muscle has its rise.—— From the nitch to the termination of the *fossa* for the *teres minor*, the *scapula* is narrower than any where else, and supports the third process. This part has the name of *cervix*.

The whole *dorsum* of the *scapula* is always said to be convex; but, by reason of the raised edges that surround it, it is divided into two cavities by the spine, which is stretched from behind forewards, much nearer to the superior than to the inferior *costa*.—The cavity above the spine is really concave where the *supra spinatus* muscle is lodged; while the surface of this bone below the spine, on which the *infra-spinatus* muscle is placed, is convex, except a *fossa* that runs at the side of the *inferior costa*.

The internal or anterior surface of this bone is hollow, except in the part above the spine, which is convex.—— The *subscapularis* muscle is extended over this surface, where it forms several ridges and intermediate depressions, commonly mistaken for prints of the ribs; they point out the interstices of the bundles of fibres

fibres of which the *subscapularis* muscle is composed (*a*).

The spine * rises small at the base of the *scapula*, and becomes higher and broader as it advances forewards.——On the sides it is unequally hollowed and crooked, by the actions of the adjacent muscles.——Its ridge † is divided into two rough flat surfaces: Into the upper one, the *trapezius* muscle is inserted; and the lower one has part of the *deltoid* fixed to it.——The end of the spine, called *acromion* ‡, or top of the shoulder, is broad and flat, and is sometimes only joined to the spine by a cartilage (*b*).——The anterior edge of the *acromion* is flat, smooth, and covered with a cartilage, for its articulation with the external end of the clavicle; and it is hollowed below, to allow a passage to the *infra* and *supra spinati* muscles, and free motion to the *os humeri*.

The *coracoid* § process is crooked, with its point inclining forewards; so that a hollow is left at the lower side of its root, for the passage of the *infra-scapularis* muscle.——The end of this process is marked with three plain surfaces, Into the internal, the *serratus minor anticus* is inserted: From the external, one head of the *biceps flexor cubiti* rises; and from the lower one, the *cor acobrachialis* has

(*a*) Winslow, in Memoires de l'acad. des sciences, 1722.

* Ῥαχις, ὑπεροχη ωμοπλατῶν, eminentia scapularum.

† Pterigium, crista.

‡ Ἔπωμις, ἀγκυροειδης, κορακοειδης, κατακλεις, acromii os, summus armus, rostrum porcinum, processus digitalis.

(*b*) Sue Trad. d'osteol. p. 160.

§ Ἀγκυροειδης, σιγμοειδης, rostriformis.

has its origin.——At the upper-part of the root of this proceſs, immediately before the *ſemilunar* cavity, a ſmooth tubercle appears, where a ligament from the *clavicle* is fixed. From all the external ſide of this coracoid *apophyſe*, a broad ligament goes out, which becomes narrower where it is fixed to the *acromion*.——The ſharp pain, violent inflammation, and tedious cure of contuſions in this part, are probably owing to theſe tendons and ligaments being hurt.

From the *cervix ſcapulæ* the third proceſs is produced. The fore part of this is formed into a *glenoid* cavity *, which is of the ſhape of the longitudinal ſection of an egg, being broad below, and narrow above.——Between the brims of this hollow and the fore-part of the root of the ſpine, a large ſinuoſity is left for the tranſmiſſion of the *ſupra* and *infra ſpinati* muſcles; and on the upper-part of theſe brims we may remark a ſmooth ſurface, where the ſecond head of the *biceps flexor cubiti* has its origin.——The root of the *ſupercilia* is rough all round, for the firmer adheſion of the capſular ligament of the articulation, and of the cartilage which is placed on theſe brims, where it is thick, but becomes very thin as it is continued towards the middle of the cavity, which it lines all over.

The medullary veſſels enter the *ſcapula* near the baſe of the ſpine.

The

* Ωμοκότυλις.

The ſubſtance of the *ſcapula*, as in all other broad flat bones, is cellular, but of an unequal thickneſs; for the neck and third proceſs are thick and ſtrong. The inferior *coſta*, ſpine, and coracoid proceſs, are of a middle thickneſs; and the body is ſo preſſed by the muſcles, as to become thin and diaphanous.

The *ſcapula* and clavicle are joined by plain ſurfaces, tipped with cartilage*: by which neither bone is allowed any conſiderable motion, being tightly tied down by the common capſular ligament, and by a very ſtrong one which proceeds from the coracoid proceſs; but divides into two before it is fixed into the *clavicle*, with a ſuch a direction, as either can allow this bone to have a ſmall rotation, in which its poſterior edge turns more backwards, while the anterior one riſes farther forewards; or it can yield to the forepart of the *ſcapula* moving downwards, while the back-part of it is drawn upwards; in both which caſes, the oblong ſmooth articulated ſurfaces of the *clavicle* and *ſcapula* are not in the ſame plane, but ſtand a little tranſverſely, or acroſs each other, and thereby preſerve this joint from luxations, to which it would be ſubject, if either of the bones was to move on the other perpendicularly up and down, without any rotation.—Sometimes a moveable ligamentuous cartilage is found in this joint; otherwhiles ſuch a cartilage is only interpoſed at the anterior half of it; and in ſome old ſubjects I have found a ſeſamoid bone

* Acromion. κατακλεις, clauſuræ.

bone here (*a*).——The *scapula* is connected to the head, *os hyoides*, *vertebræ*, ribs, and arm-bone, by muscles, that have one end fastened to these bones, and the other to the *scapula*, which can move it upwards, downwards, backwards, or forewards; by the quick succession of these motions, its whole body is carried in a circle. But being also often moved as upon an axis perpendicular to its plane, its circumference turns in a circle whose center this axis is (*b*). Which ever of these motions it performs, it always carries the outer end of the clavicle and the arm along with it.——— The *glenoid* cavity of this bone receives the *os humeri*, which plays in it as a ball in a socket, as will be explained more hereafter.

The use of the *scapula* is, to serve as a *fulcrum* to the arm; and, by altering its position on different occasions, to allow always the head of the *os humeri* a right situated socket to move in; and thereby to assist and to enlarge greatly the motions of the *superior extremity*, and to afford the muscles which rise from it more advantageous actions, by altering their directions to the bone which they are to move.——This bone also serves to defend the back-part of the *thorax*, and is often employed to sustain weights, or to resist forces, too great for the arm to bear.

The base, *acromion*, coracoid process, and head of the *scapula*, are all in a cartilaginous state at birth; and the three first are joined as *epiphyses*; while the head, with the *glenoid* cavity

(*a*) Jac. Sylv. Isagog. anat. lib. 1. cap. 2.
(*b*) See Winslow, Memoires de l'acad. des sciences, 1726.

cavity, is not formed into a distinct separate bone, but is gradually produced by the ossification of the body of this bone being continued forewards.

The *ARM* has only one bone, best known by the *Latin* name of *os humeri* *; which is long, round, and nearly streight.

The upper end of this bone † is formed into a large round smooth head, whose middle point is not in a streight line with the axis of the bone, but stands obliquely backwards from it.——The extent of the head is distinguished by a circular *fossa* surrounding its base, where the head is united to the bone, and the capsular ligament of the joint is fixed.———Below the fore-part of its base two tubercles stand out: The smallest one, which is situated most to the inside, has the tendon of the *subscapularis* muscle inserted into it.——The larger more external protuberance is divided, at its upper part, into three smooth plain surfaces; into the anterior of which, the *musculus supra spinatus*; into the middle or largest, the *infra-spinatus*; into the one behind, the *teres minor*, is inserted.——Between these two tubercles, exactly in the fore part of the bone, a deep long *fossa* is formed, for lodging the tendinous head of the *biceps flexor cubiti*; which, after passing, in a manner peculiar to itself, through the cavity of the articulation, is tied down by a tendinous sheath extended across the *fossa*; in which, and in the neighbouring tubercles, are

† Ἀκρολία, ὠλένη os brachii, armi, adjutorium, parvum brachium, canna brachii.

* Acrocolium.

several remarkable holes, which are penetrated by the tendinous and ligamentous fibres, and by vessels.——On each side of this *fossa*, as it descends in the *os humeri*, a rough ridge, gently flatted in the middle, runs from the roots of the tubercles.———The tendon of the *pectoral* muscle is fixed into the anterior of these ridges, and the *latissimus dorsi*, and *teres major*, are inserted into the internal one. ——A little behind the lower end of this last another rough ridge may be observed, where the *coraco brachialis* is inserted.——From the back part of the root of the largest tubercle a ridge also is continued, from which the *brevis extensor cubiti* rises. ——This bone is flatted on the inside, about its middle, by the belly of the *biceps flexor cubiti*.——In the middle of this plain surface, the entry of the medullary artery is seen slanting obliquely downwards. ——At the fore side of this plane the bone rises in a sort of ridge, which is rough, and often has a great many small holes in it, where the tendon of the strong *deltoid* muscle is inserted; on each side of which the bone is smooth and flat, where the *brachiæus internus* rises. The exterior of these two flat surfaces is the largest; behind it a superficial spiral channel, formed by the *muscular* nerve and the vessels that accompany it, runs from behind forewards and downwards.——The body of the *os humeri* is flatted behind by the extensors of the fore-arm.———Near the lower end of this bone, a large sharp ridge is extended on its outside, from which the *musculus spinator radii longus*, and the longest

head

head of the *extenſor carpi radialis* riſe.——— Oppoſite to this, there is another ſmall ridge to which the *aponeurotic* tendon, that gives origin to the fibres of the internal and external *brachiæi* muſcles is fixed; and from a little depreſſion on the fore-ſide of it, the *pronator radii teres* riſes.

The body of the *os humeri* becomes gradually broader towards the lower end, where it has ſeveral proceſſes; at the roots of which, there is a cavity before, and another behind *. The anterior is divided by a ridge into two; the external, which is the leaſt, receives the end of the *radius*; and the internal receives the *coronoid* proceſs of the *ulna* in the flections of the fore-arm, while the poſterior deep triangular cavity lodges the *olecranon* in the extenſions of that member.——— The bone betwixt theſe two cavities is preſſed ſo thin by the proceſſes of the *ulna*, as to appear diaphanous in ſeveral ſubjects. ———The ſides of the poſterior cavity are ſtretched out into two proceſſes, one on each ſide: Theſe are called *condyles*; from each of which a ſtrong ligament goes out to the bones of the *fore-arm*. ———The external *condyle*, which has an oblique direction alſo forewards in reſpect of the internal, when the arm is in the moſt natural poſture (*a*), is equally broad, and has an obtuſe ſmooth head riſing from it forewards.— From the rough part of the *condyle*, the inferior head of the *bicornis*, the *extenſor digitorum communis*, *extenſor carpi ulnaris* and *concæus*

* βαδμιδες,

(*a*) Winſlow, Memoires de l'acad. des ſciences, 1722.

conœus, and ſome part of the *ſupinator radii brevis*, take their riſe; and on the ſmooth head the upper end of the *radius* plays.—— Immediately on the outſide of this, there is a ſinuoſity made by the ſhorter head of the *bicornis* muſcle, upon which the *muſcular* nerve is placed.——The internal *condyle* is more pointed and protuberant than the external, to give origin to ſome part of the *flexor carpi radialis*, *pronator radii teres*, *palmaris longus*, *flexor digitorum ſublimis*, and *flexor carpi ulnaris*. Between the two *condyles*, is the *trochlea* or pully, which conſiſts of two lateral protuberances, and a middle cavity, that are ſmooth and covered with cartilage. —When the forearm is extended, the tendon of the internal *brachiœus* muſcle is lodged in the fore part of the cavity of this pully.—The external protuberance, which is leſs than the other, has a ſharp edge behind; but forewards, this ridge is obtuſe, and only ſeparated from the little head, already deſcribed, by a ſmall *foſſa*, in which the joined edges of the *ulna* and *radius* move.—— The internal protuberance of the pully is largeſt and higheſt; and therefore in the motions of the *ulna* upon it, that bone would be inclined outwards, was it not ſupported by the *radius* on that ſide.—Between this internal protuberance and *condyle*, a ſinuoſity may be remarked, where the *ulnar* nerve paſſes.

The ſubſtance and the internal ſtructure of the *os humeri* is the ſame, and diſpoſed in the ſame way, as in other long bones.

The round head at the upper end of this bone is articulated with the *glenoid* cavity of the

the *ſcapula*; which being ſuperficial, and having long ligaments, allows the arm a free and extenſive motion.——Theſe ligaments are however conſiderably ſtrong. For, beſides the common capſular one, the tendons of the muſcles perform the office, and have been deſcribed under the name of *ligaments*.——Then the *acromion* and *coracoid* proceſs, with the ſtrong broad ligaments ſtretched betwixt them, ſecure the articulation above, where the greateſt and moſt frequent force is applied to thruſt the head of the bone out of its place. It is true that there is not near ſo ſtrong a defence at the lower part of the articulation; but in the ordinary poſtures of the arm, that is, ſo long as it is at an acute angle with the trunk of the body, there cannot be any force applied at this place to occaſion a luxation, ſince the joint is protected ſo well above.

The motions which the arm enjoys by this articulation, are to every ſide; and by the ſucceſſion of theſe different motions, a circle may be deſcribed. Beſides which, the bone performs a ſmall rotation round its own *axis*. But though this can be performed with the round head in all poſitions; yet as theſe vary, the effects upon the body of the bone are very different: For, if the middle of the head is the center of rotation, as it is when the arm hangs down by the ſide, the body of the bone is only moved forewards and backwards; becauſe the *axis* of motion of the head is near-

ly at right angles with the length of the bone (*a*); whereas, when the arm is raised to right angles with the trunk of the body, the center of motion, and the axis of the bone, come to be in the same streight line; and therefore the body of the *os humeri* performs the same motion with its head.——————Though the motions of the arm seem to be very extensive, yet the larger share of them depends on the motion of the *scapula*—The lower end of the *os humeri* is articulated with the bones of the fore-arm, and carries them with it in all its motions, but serves as a base on which they perform the motions peculiar to themselves; as shall be described afterwards.

Both the ends of this bone are cartilaginous in a new-born infant, and the large head with the two tubercles, and the *trochlea* with the two *condyles*, become *epiphyses* before they are united to the body of the bone.

The *FOREARM* † consists of two long bones, the *ulna* and *radius*; whose situation, in respect of each other, is oblique in the least straining or most natural posture; that is, the *ulna* is not directly behind, nor on the outside of the *radius*, but in a middle situation between these two, and the *radius* crosses it.—The situation however of these two bones, and of all the other bones of the *superior extremity* that are not yet described, is frequently altered; and therefore, to shun repetitions, I desire it may be now remarked, that, in the remaining account of the *superior extremity*, I understand by the term

(*a*) Hippocrat. de articul. § 1.

† Cubitus, πῆχυς, ὠλένη, πυγών, ulna, lacertus.

term of *posterior*, that part which is in the same direction with the back of the hand; by *anterior*, that answering to the palm; by *internal*, that on the same side with the thumb; by *external*, the side neareſt to the little finger; ſuppoſing the hand always to be in a middle poſition between *pronation* and *ſupination*.

ULNA †, ſo named from its being uſed as a meaſure, is the longeſt of the two bones of the fore-arm, and ſituated on the outſide of the *radius*.

At the upper end of the *ulna* are two proceſſes.—The poſterior is the largeſt, and formed like a hook, whoſe concave ſurface moves upon the pully of the *os humeri*, and is called *olecranon* ‡, or top of the cubit.—The convex back-part of it is rough and ſcabrous, where the *longus*, *brevis*, and *brachiæus externus*, are inſerted. The *olecranon* makes it unneceſſary that the tendons of the extenſor muſcles ſhould paſs over the end of the *os humeri*; which would have been of ill conſequence in the great flections of this joint, or when any conſiderable external force is applied to this part (*a*).—The anterior proceſs is not ſo large, nor does it reach ſo high as the one behind; but is ſharper at its end, and therefore is named *coronoid*.—Between theſe two proceſſes, a large ſemicircular or *ſigmoid* concavity is left; the ſurface of which, on

† Cubitus, πῆχυς, προπῆχυον, focile majus, canna vel arundo major, et inferior brachii.

‡ Ἀγκών, gibber cubitus, additamentum necatum.

(*a*) Winſlow, Expoſition anatomique du corps humain, traite des os ſecs, § 979.

on each side of a middle rising, is slanting, and exactly adapted to the pully of the bone of the arm.——Across the middle of it, there is a small sinuosity for lodging mucilaginous glands; where, as well as in a small hollow on the internal side of it, the cartilage that lines the rest of its surface is wanting——Round the brims of this concavity the bone is rough, where the capsular ligament of the joint is implanted.——Immediately below the *olecranon*, on the back-part of the *ulna*, a flat triangular spongy surface appears, on which we commonly lean.—At the internal side of this, there is a larger hollow surface, where the *musculus anconæus* is lodged; and the ridge at the inside of this gives rise to the *musculus supinator radii brevis*.——Between the top of the ridge and the *coronoid* process is the semilunated smooth cavity, lined with cartilage, in which, and a ligament extended from the one to the other end of this cavity, the round head of the *radius* plays.—Immediately below it a rough hollow gives lodging to mucilaginous glands.—Below the root of the *coronoid* process, this bone is scabrous and unequal, where the *brachiæus internus* is inserted.—On the outside of that we observe a smooth concavity, where the beginning of the *flexor digitorum profundus* sprouts out.

The body of the *ulna* is triangular.——The internal angle is very sharp where the ligament that connects the two bones is fixed;—The sides, which make this angle, are flat and rough, by the action and adhesion of the many muscles which are situated here.——At the distance

distance of one third of the length of the *ulna* from the top, in its fore-part, the passage of the medullary vessels is to be remarked slanting upwards.——The external side of this bone is smooth, somewhat convex, and the angles at each edge of it are blunted by the pressure of the muscles equally disposed about them.

As this bone descends, it becomes gradually smaller; so that its lower end terminates in a little head, standing on a small neck.——Towards the fore but outer part of which last, an oblique ridge runs, that gives rise to the *pronator radii quadratus*.——The head is round, smooth, and covered with a cartilage on its internal side, to be received into the semilunar cavity of the *radius*; while a *styloid* process † rises from its outside, to which is fixed a strong ligament that is extended to the *os cuneiforme* and *pisiforme* of the wrist.—Between the back-part of that internal smooth side and this process, a sinuosity is left for the tendon of the *extensor carpi ulnaris*.——On the fore part of the root of the process, such another depression may be remarked for the passage of the *ulnar* artery and nerve.—The end of the bone is smooth, and covered with a cartilage.—Between it and the bones of the wrist, a doubly-concave moveable cartilage is interposed; which is a continuation of the cartilage that covers the lower end of the *radius*, and is connected loosely to the root of the *styloid* process, and to the rough cavity there; in which mucilaginous glands are lodged.

The

† Παραπηχυς, malleolus externus.

The *ulna* is articulated above with the lower end of the *os humeri*, where these bones have depressions and protuberances corresponding to each other, so as to allow an easy and secure extension of the fore-arm to almost a streight line with the arm, and flection to a very acute angle; but, by the slanting position of the pully, the lower part of the fore-arm is turned outwards in the extension, and inwards in the flection (*a*); and a very small kind of rotation is likewise allowed in all positions, especially when the ligaments are most relaxed by the fore-arm being in a middle degree of flection. ——The *ulna* is also articulated with the *radius* and *carpus*, in a manner to be related afterwards.

RADIUS *, so called from its imagined resemblance to a spoke of a wheel, or to a weaver's beam, is the bone placed at the inside of the fore-arm. Its upper end is formed into a circular little head, which is hollowed for an articulation with the tubercle at the side of the pully of the *os humeri*; and the half of the round circumference of the head next to the *ulna* is smooth, and covered with a cartilage, in order to be received into the semilunated cavity of that bone.——below the head, the *radius* is much smaller; therefore this part is named its *cervix*, which is made round by the action of the *supinator radii brevis*.——At the external root of this neck, a tuberous process rises; into the outer part of which the *biceps flexor cubiti* is inserted.——From this a ridge runs downwards and inwards, where the *supinator*

(*a*) Winslow, Memoires de l' acad. des sciences, 1722.

* Κερκις, παραπηχιον, focile minus, canna minor, arundo minor.

ſupinator radii brevis is inſerted; and a little below, and behind this ridge, there is a rough ſcabrous ſurface, where the *pronator radii teres* is fixed.

The body of the *radius* is not ſtreight, but convex on its internal and poſterior ſurfaces; where it is alſo made round by the equal preſſure of the circumjacent muſcles, particularly of the *extenſors* of the thumb; but the ſurfaces next to the *ulna* are flatted and rough, for the origin of the muſcles of the hand; and both terminate in a common ſharp ſpine, to which the ſtrong ligament extended betwixt the two bones of the fore-arm is fixed.—A little below the beginning of the plain ſurface, on its fore-part, where the *flexor* muſcle of the laſt joint of the thumb takes its origin, the paſſage of the medullary veſſels is ſeen ſlanting upwards. ——The *radius* becomes broader and flatter towards the lower end, eſpecially on its fore-part, where its *pronator quadratus* muſcle is ſituated.

The lower end of the *radius* is larger than the ſuperior: though not in ſuch a diſproportion as the upper end of the *ulna* is larger than its lower end.—— Its back-part has a flat ſtrong ridge in the middle, and *foſſæ* on each ſide.—In a ſmall groove immediately on the outſide of the ridge, the tendon of the *extenſor tertii internodii policis* plays.——In a large one beyond this, the tendons of the *indicator* and of the common *extenſor* muſcles of the fingers paſs.—Contiguous to the *ulna*, there is a ſmall depreſſion made by the *extenſor minimi digiti*. ——On the inſide of the ridge there is a broad depreſſion

depreſſion, which ſeems again ſubdivided, where the two tendons of the *biccrnis*, or *extenſor carpi radialis*, are lodged.—The internal ſide of this end of the *radius* is alſo hollowed by the extenſors of the firſt and ſecond joint of the thumb; immediately above which, a little rough ſurface ſhews where the *ſupinator radii longus* is inſerted.———The ridges at the ſides of the grooves, in which the tendons play, have an angular ligament fixed to them, by which the ſeveral ſheaths for the tendons are formed.———The fore-part of this end of the *radius* is alſo depreſſed, where the flexors of the fingers and *flexor carpi radialis* paſs.——The external ſide is formed into a ſimilunated ſmooth cavity, lined with a cartilage, for receiving the lower end of the *ulna*.———The loweſt part of the *radius* is formed into an oblong cavity; in the middle of which is a ſmall tranſverſe riſing, gently hollowed, for lodging mucilaginous glands; while the riſing itſelf is inſinuated into the conjunction of the two bones of the wriſt that are received into the cavity.——The internal ſide of this articulation is fenced by a remarkable proceſs * of the *radius*, from which a ligament goes out to the wriſt, as the *ſtyloid* proceſs of the *ulna* with its ligament guards it on the outſide.

The ends of both the bones of the fore-arm being thicker than the middle, there is a conſiderable diſtance between the bodies of theſe bones; in the larger part of which a ſtrong tendinous, but thin ligament, is extended, to give a large enough ſurface for the origin of

* Malleolus internus, proceſſus ſtyloides.

of the numerous fibres of the muſcles ſituated here, that are ſo much ſunk between the bones, as to be protected from injuries, which they would otherwiſe be expoſed to. But this ligament is wanting near the upper end of the fore-arm, where the *ſupinator radii brevis*, and *flexor digitorum profundus*, are immediately connected (*a*).

Both ends of the bones of the fore-arm are firſt cartilages, and then *epiphyſes* in children.

As the head of the *radius* receives the tubercle of the *os humeri*, it is not only bended and extended along with the *ulna*, but may be moved round its *axis* in any poſition; and that this motion round its *axis* may be ſufficiently large, the ligament of the articulation is extended farther down than ordinary on the neck of this bone, before it is connected to it; and it is very thin at its upper and lower part, but makes a firm ring in the middle.——This bone is alſo joined to the *ulna* by a double articulation; for above, a tubercle of the *radius* plays in a ſocket of the *ulna*; whilſt below, the *radius* gives the ſocket, and the *ulna* the tubercle: But then the motion performed in theſe two is very different; for at the upper end, the *radius* does no more than turn round its axis; while at the lower end, it moves in a ſort of *cycloid* upon the round part of the *ulna*; and as the hand is articulated and firmly connected here with the *radius*, they muſt move together. ——

Y When

(*a*) Weitbrecht. Syndeſmolog. ſ. 10. 11.

When the palm is turned uppermoſt, the *radius* is ſaid to perform the *ſupination*; when the back of the hand is above, it is ſaid to be *prone*. But then the quickneſs and large extent of theſe two motions are aſſiſted by the *ulna*, which, as was before obſerved, can move with a kind of ſmall rotation on the ſloping ſides of the pulley. This lateral motion, tho' very inconſiderable in the joint itſelf, is conſpicuous at the lower end of ſuch a long bone; and the ſtrong ligament connecting this lower end to the *carpus*, makes the hand more readily to obey theſe motions.——When we deſign a large circular turn of our hand, we increaſe it by the rotation of the *os humeri*, and ſometimes employ the ſpine and *inferior extremities* to make theſe motions of pronation or ſupination of the hand large enough.

The *HAND* * comprehends all from the joint of the wriſt to the points of the fingers. Its back-part is convex, for greater firmneſs and ſtrength; and it is concave before, for containing more ſurely and conveniently ſuch bodies as we take hold of.——One half of the hand has an obſcure motion in compariſon of what the other has, and ſerves as a baſe to the moveable half; which can be extended back very little farther than to a ſtreight line with the fore-arm, but can be conſiderably bended forewards.

As the bones that compoſe the hand are of different ſhapes and uſes, while ſeveral of them that are contiguous agree in ſome general characters; the hand is, on this account, commonly

* Ἀκρόχειρ, ſumma manus.

ly divided into the *carpus*, *metacarpus*, and *fingers*; among which laſt the thumb is reckoned.

The *CARPUS* * is compoſed of eight ſmall ſpongy bones, ſituated at the upper part of the hand. I ſhall deſcribe each of theſe bones, under a proper name taken from their figure (*a*); becauſe the method of ranging them by numbers leaves anatomiſts too much at liberty to debate very idly, which ought to be preferred to the firſt number; or, which is worſe, ſeveral, without explaining the order they obſerve, differently apply the ſame numbers, and ſo confound their readers.——But that the deſcription of theſe bones may be in the ſame order as they are found in the generality of anatomical books, I ſhall begin with the range of bones that are concerned in the moveable joint of the wriſt, or are connected to the fore arm, and ſhall afterwards conſider the four that ſupport the thumb and *oſſa metacarpi* of the fingers.

The eight bones of the *carpus* are, *os ſcaphoides*, *lunare*, *cuneiforme*, *piſiforme*, *trapezium*, *trapezoides*, *magnum*, *unciforme*.

The *ſcaphoides* is ſituated moſt internally of thoſe that are articulated with the fore-arm.—The *lunare* is immediately on the outſide of the former.——The *cuneiforme* is placed ſtill more externally, but does not reach ſo high up as the other two.—The *piſiforme* ſtands forewards into the palm from the *cuneiforme*.—The *trapezium* is the firſt of the ſecond row, and is ſituated betwixt the *ſcaphoides* and firſt joint

* Κρσις, brachiale, prima palmæ pars, raſetta.

(*a*) Lyſer. Cult. anat. lib. 5. cap. 2.

of the thumb.——The *trapezoides* is immediately on the outside of the *trapezium*.——The *os magnum* is still more external.——The *unciforme* is farther to the side of the little finger.

Os scaphoides * is the largest of the eight except one. It is convex above, concave and oblong below; from which small resemblance of a boat it has got its name.—Its smooth convex surface is divided by a rough middle *fossa*, which runs obliquely cross it.——The upper largest division is articulated with the *radius*.—Into the *fossa* the common ligament of the joint of the wrist is fixed; and the lower division is joined to the *trapezium* and *trapezoides*.——The concavity receives more than an half of the round head of the *os magnum*.——The external side of this hollow is formed into a semilunar plane, to be articulated with the following bone.——The internal, posterior, and anterior edges are rough, for fixing the ligaments that connect it to the surrounding bones.

Os lunare † has a smooth convex upper surface, by which it is articulated with the *radius*.——The internal side, which gives the name to the bone, is in the form of a crescent, and is joined with the *scaphoid*;——the lower surface is hollow, for receiving part of the head of the *os magnum*——On the outside of this cavity is another smooth, but narrow oblong sinuosity, for receiving the upper end of the *os unciforme*:——On the outside of which

* Κοτυλοειδες, naviculare.

† Lunatum.

which a small round convexity is found, for its connection with the *os cuneiforme*.——Between the great convexity above, and the first deep inferior cavity, there is a rough *fossa*, in which the circular ligament of the joint of the wrist is fixed.

*Os cuneiforme** is broader above, and towards the back of the hand, than it is below and forewards: which gives it the resemblance of a wedge.———The superior slightly convex surface is included in the joint of the wrist, being opposed to the lower end of the *ulna*.——

Below this the cuneiform bone has a rough *fossa*, wherein the ligament of the articulation of the wrist is fixed.——On the internal side of this bone, where it is contiguous to the *os lunare*, it is smooth and slightly concave.—Its lower surface, where it is contiguous to the *os unciforme* is oblong, somewhat spiral, and concave.———Near the middle of its anterior surface a circular plane appears, where the *os pisiforme* is sustained.

Os pisiforme † is almost spherical, except one circular plane, or slightly hollow surface, which is covered with cartilage for its motion on the *cuneiforme* bone, from which its whole rough body is prominent forewards into the palm; having the tendon of the *flexor carpi ulnaris*, and a ligament from the *styloid* process of the *ulna*, fixed to its upper part; the *transverse* ligament of the wrist is connected to its internal side; ligaments extended to the *unciform* bone, and to the *os metacarpi* of the

* Triquetrum.

† Cartilaginosum; subrotundum, rectum.

little finger, are attached to its lower part; the *abductor minimi digiti* has its origin from its fore-part; and, at the internal side of it, a small depression is formed, for the passage of the ulnar nerve.

Trapezium * has four unequal sides and angles in its back-part, from which it has got its name——Above, its surface is smooth, slightly hollowed, and semicircular, for its conjunction with the *os scaphoides*.——Its external side is an oblong concave square, for receiving the following bone.——The inferior surface is formed into a pulley; the two protuberant sides of which are external and internal. On this pulley the first bone of the thumb is moved——At the external side of the external protuberance, a small oblong smooth surface is formed by the *os metacarpi indicis*.——The fore part of the *trapezium* is prominent in the palm, and, near to the external side, has a sinuosity in it, where the tendon of the *flexor carpi radialis* is lodged; on the ligamentous sheath of which the tendon of the *flexor tertii internodii pollicis* plays: And still more externally the bone is scabrous, where the *transverse* ligament of the wrist is connected, the *abductor* and *flexor primi internodii pollicis* have their origin, and ligaments go out to the first bone of the thumb.

Os trapezoides †, so called from the irregular quadrangular figure of its back-part, is the smallest bone of the wrist, except the *pisiforme*.——The figure of it is an irregular cube.

* Os cubiforme, trapezoides, multangulum, majus.
† Trapezium, multangulum minus.

cube.——It has a small hollow surface above, by which it joins the *scaphoides*; a long convex one internally, where it is contiguous to the *trapezium*; a small external one, for its conjunction with the *os magnum*; and an inferior convex surface, the edges of which are however so raised before and behind, that a sort of pulley is formed, where it sustains the *os metacarpi indicis*.

Os magnum *, so called because it is the largest bone of the *carpus*, is oblong, having four quadrangular sides, with a round upper end, and a triangular plain one below——The round head is divided by a small rising, opposite to the connection of the *os scaphoides* and *lunare*, which together form the cavity for receiving it.——On the inside a short plain surface joins the *os magnum* to the *trapezoides*.——On the outside is a long narrow concave surface, where it is contiguous to the *os unciforme*.——The lower end, which sustains the metacarpal bone of the middle finger, is triangular, slightly hollowed, and farther advanced on the internal side than on the external, having a considerable oblong depression made on the advanced inside by the metacarpal bone of the fore-finger; and generally there is a small mark of the *os metacarpi digiti annularis* on its external side.

Os unciforme † has got its name from a thin broad process that stands out from it forewards into the palm, and is hollow on its inside, for affording passage to the tendons of the

* Maximum, capitatum.
† Cuneiforme.

the flexors of the fingers. To this process also the transverse ligament is fixed, that binds down and defends these tendons; and the *flexor* and *abductor* muscles of the little finger have part of their origin from it.——The upper plain surface is small, convex, and joined with the *os lunare*:——The internal side is long, and slightly convex, adapted to the contiguous *os magnum*:——The external surface is oblique, and irregularly convex, to be articulated with the cuneiform bone:——The lower end is divided into two concave surfaces; the external is joined with the metacarpal bone of the little finger, and the internal one is fitted to the metacarpal bone of the ring-finger.

In the description of the preceeding eight bones, I have only mentioned those plain surfaces covered with cartilage, by which they are articulated to each other, or to some other bones, except in some few cases, where something extraordinary was to be observed; and I have designedly omitted the other rough surfaces, lest, by crowding too many words in the description of such small bones, the whole should be unintelligible: But these scabrous parts of the bones may easily be understood, after mentioning their figure, if it is observed, that they are generally found only towards the back or palm of the hand; that they are all plain, larger behind than before; and that they receive the different ligaments, by which they are either connected to neighbouring bones, or to one another; for these ligaments cover all the bones, and are so accurately

curately applied to them, that, at firſt view, the whole *carpus* of a recent ſubject appears one ſmooth bone (*a*).

As the ſurfaces of theſe bones are largeſt behind, the figure of the whole conjoined muſt be convex there, and concave before; which concavity is ſtill more increaſed by the *os piſiforme*, and proceſs of the *os unciforme*, ſtanding forewards on one ſide, as the *trapezium* does on the other: And the bones are ſecurely kept in this form, by the broad ſtrong tranſverſe ligament connected to theſe parts of them that ſtand prominent into the palm of the hand.——The convexity behind renders the whole fabric ſtronger, where it is moſt expoſed to injuries; and the large anterior hollow is neceſſary for a ſafe paſſage to the numerous veſſels, nerves, and tendons of the fingers.

The ſubſtance of theſe bones is ſpongy and cellular, but ſtrong in reſpect of their bulk.

The three firſt bones of the *carpus* make an oblong head, by which they are articulated with the cavity at the lower ends of the bones of the fore-arm; ſo as to allow motion to all ſides, and, by a quick ſucceſſion of theſe motions, they may be moved in a circle. But as the joint is oblong, and therefore the two dimenſions are unequal, no motion is allowed to the *carpus* round its axis, except what it has

(*a*) Galen. de uſu part. lib. 2. cap. 8. For a particular deſcription of theſe ligaments, ſee Weitbrecht. Syndeſmolog. p. 5.—68.

has in the pronation and ſupination along with the *radius*.———The articulation of the firſt three bones of the ſuperior row, with the bones of the inferior, is ſuch as allows of motion, eſpecially backwards and forewards; to the ſecurity and eaſineſs of which the reception of the *os magnum* into the cavity formed by the *ſcaphoides* and *lunare* contributes conſiderably: And the greateſt number of the muſcles that ſerve for the motion of the wriſt on the *radius*, being inſerted beyond the conjunction of the firſt row of bones with the ſecond, act equally on this articulation as they do on the former; but the joint formed with the *radius* being the moſt eaſily moved, the firſt effect of theſe muſcles is on it; and the ſecond row of the *carpus* is only moved afterwards. By this means a larger motion of the wriſt is allowed, than otherwiſe it could have had ſafely: For, if as large motion had been given to one joint, the angle of flection would have been very acute, and the ligaments muſt have been longer than was conſiſtent with the firmneſs and ſecurity of the joint.——The other articulations of the bones here being by nearly plain ſurfaces, ſcarce allow of any more motion, becauſe of the ſtrong connecting ligaments, than to yield a little, and ſo elude the force of any external power; and to render the back of the wriſt a little more flat, or the palm more hollow, on proper occaſions. The articulations of the thumb and metacarpal bones ſhall be examined afterwards.

The

The uſes of the *carpus* are to ſerve as a baſe to the hand, to protect its tendons, and to afford it a free large motion.

All the bones of the *carpus* are in a cartilaginous ſtate at the time of birth.

On account of the many tendons that paſs upon the lower end of the fore-arm and the *carpus*, and of the numerous ligaments of theſe tendons and of the bones, which have lubricating liquors ſupplied to them, the pain of ſprains here is acute, the parts take long time to recover their tone, and their ſwellings are very obſtinate.

*METACARPUS** conſiſts of four bones which ſuſtain the fingers.———Each bone is long and round, with its ends larger than its body.——The upper end, which ſome call the baſe, is flat and oblong, without any conſiderable head or cavity; but it is however ſomewhat hollowed, for the articulation with the *carpus*: It is made flat and ſmooth on the ſides where theſe bones are contiguous to each other. ——Their bodies are flatted on their back-part by the tendons of the extenſors of the fingers. ——The anterior ſurface of theſe bodies is a little concave, eſpecially in their middle; along which a ſharp ridge ſtands out, which ſeparates the *muſculi interoſſei* placed on each ſide of theſe bones which are there made flat and plain by theſe muſcles.

Their lower ends are raiſed into large oblong ſmooth heads, whoſe greateſt extent is forewards from the axis of the bone.—At the fore-

* Κτείς, προκαρπιον, σῆδος, ἄνδηρον, κτενίον, poſtbrachiale, pectus, palma, pecten.

fore-part of each ſide of the root of each of theſe heads, one or two tubercles ſtand out, for fixing the ligaments that go from one metacarpal bone to another, to preſerve them from being drawn aſunder:—Round the heads a rough ring may be remarked, for the capſular ligaments of the firſt joints of the fingers to be fixed to; and both ſides of theſe heads are flat, by preſſing on each other.

The ſubſtance of the metacarpal bones is the ſame with that of all long bones.

At the time of birth, theſe bones are cartilaginous at both ends, which afterwards become *epiphyſes*.

The metacarpal bones are joined above to the *oſſa carpi* and to each other by nearly plain ſurfaces. Theſe connections are not fit for large motions.——The articulation of their round heads at the lower ends with the cavities of the firſt bones of the fingers, is to be taken notice of hereafter.

The concavity on the fore-part of theſe metacarpal bones, and the placing their baſes on the arched *carpus*, cauſe them to form a hollow in the palm of the hand, which is uſeful often to us.—The ſpaces between them lodge muſcles, and their ſmall motion makes them fit ſupporters for the fingers to play on.

Though the *oſſa metacarpi* ſo far agree, yet they may be diſtinguiſhed from each other by the following marks.

The *os metacarpi indicis* is generally the longeſt.—Its baſe, which is articulated with the

os-

os trapezoides, is hollow in the middle.——The small ridge on the internal side of this oblong cavity is smaller, than the one opposite to it, and is made flat on the side by the *trapezium*. ——The exterior ridge is also smooth, and flat on its outside, for its conjunction with the *os magnum*; immediately below which a semicircular smooth flat surface shews the articulation of this to the second metacarpal bone.——The back-part of this base is flatted, where the long head of the *extensor carpi radialis* is inserted; and its fore-part is prominent, where the tendon of the *flexor carpi radialis* is fixed.—The external side of the body of this bone is more hollowed by the action of muscles, than the internal.—The tubercle at the internal root of its head is larger than the external.—Its base is so firmly fixed to the bone it is connected with, that it has no motion

Os metacarpi medii digiti is generally the second in length; but often it is as long as the former; sometimes it is longer; and frequently it appears only to equal the first by the *os magnum* being farther advanced downwards than any other bone of the wrist.—— Its base is a broad superficial cavity, slanting outwards; the internal posterior angle of which is so prominent, as to have the appearance of a process. ——The internal side of this base is made plain in the same way as the external side of the former bone, while its external side has two hollow circular surfaces, for joining the third metacarpal bone, and between these surfaces there is a rough *fossa*, for the adhesion of a ligament, and lodging mucilaginous glands.—The short-

er head of the *bicornis* is inserted into the back-part of this base.——The two sides of this bone are almost equally flatted; only the ridge on the fore-part of the body inclines outwards. ——The tubercles at the fore-part of the root of the head are equal.——The motion of this bone is very little more than the first metacarpal one has; and therefore these two firmly resist bodies pressed against them by the thumb, or fingers, or both.

Os metacarpi digiti annularis is shorter than the second metacarpal bone.——Its base is semicircular and convex, for its conjunction with the *os unciforme*.——On its internal side are two smooth convexities, and a middle *fossa*, adapted to the second metacarpal bone.——The external side has a triangular smooth concave surface to join it with the fourth one. The anterior ridge of its body is situated more to the out than to the inside.—The tubercles near h head are eq ual.— The motion of this third metacarpal bone is greater than the motion of the second.

Os metacarpi minimi digiti is the smallest and sharpest.—Its base is irregularly convex, and rises slanting outwards —Its internal side is exactly adapted to the third metacarpal bone.—The external has no smooth surface, because it is not contiguous to any other bone; but it is prominent where the *extensor carpi ulnaris* is inserted.—As this *metacarpal* bone is furnished with a proper moving muscle, has the plainest articulation, is most loosely connected and least confined, it not only enjoys a much larger motion han any of the rest, but d rawsthe third bone with

with it, when the palm of the hand is to be made hollow by its advancement forewards, and by the prominence of the thumb oppoſite to it.

The *THUMB* and four *FINGERS* are each compoſed of three long bones.

The *Thumb* * is ſituated obliquely in reſpect of the fingers, neither oppoſite directly to them, nor in the ſame plane with them. ——All its bones are much thicker and ſtronger in proportion to their length, than the bones of the fingers are: Which was extremely neceſſary, ſince the thumb counteracts all the fingers.

The firſt bone of the thumb has its baſe adapted to the double pulley of the *trapezium*: For, in viewing it from one ſide to the other, it appears convex in the middle; but when conſidered from behind forewards, it is concave there.——The edge at the fore-part of this baſe is produced farther than any other part; and round the back-part of the baſe a rough *foſſa* may be ſeen, for the connection of the ligaments of this joint.——The body and head of this bone are of the ſame ſhape as the *oſſa metacarpi*; only that the body is ſhorter, and the head flatter, with the tubercles at the fore-part of its root larger.

The articulation of the upper end of this bone is uncommon: For though it has protuberances and depreſſions adapted to the double pulley of the *trapezium*; yet it enjoys a circular motion, as the joints do where a round head of one bone plays in the orbicular ſocket

* Αντίχειρ, διπονδυλός, magnus digitus, promanus

of another; only it is somewhat more confined and less expeditious, but stronger and more secure, than such joints generally are.

This bone of children is in the same state with the metacarpal bones.

The second bone of the thumb has a large base formed into an oblong cavity, whose greatest length is from one side to the other. —Round it several tubercles may be remarked, for the insertion of ligaments —Its body is convex, or a half round behind; but flat before, for lodging the tendon of the long flexor of the thumb, which is tied down by ligamentous sheaths that are fixed on each side to the angle at the edge of this flat surface.—The lower end of this second bone has two lateral round protuberances, and a middle cavity, whose greatest extent of smooth surface is forewards.

The articulation and motion of the upper end of this second bone is as singular as that of the former —For its cavity being joined to the round head of the first bone, it would seem at first view to enjoy motion in all directions; yet, because of the strength of its lateral ligaments, oblong figure of the joint itself, and mobility of the first joint, it only allows flection and extension; and these are generally much confined.

The third bone of the thumb is the smallest, with a large base, whose greatest extent is from one side to the other.——This base is formed into two cavities and a middle protuberance, to be adapted to the pulley of the former bone.——Its body is rounded behind; but

is

is flatter than in the former bone, for sustaining the nail.——It is flat and rough before, by the insertion of the *flexor tertii internodii*. ——This bone becomes gradually smaller, till near the lower end, where it is a little enlarged, and has an oval scabrous edge.

The motion of this third bone is confined to flection and extension.

The orderly disposition of the bones of the *fingers* into three rows, has made them generally obtain the name of three *phalanges* ‡. ——All of them have half round convex surfaces, covered with an *aponeurosis*, formed by the tendons of the *extensors*, *lumbricales*, and *interossei*, and placed directly backwards, for their greater strength, and their flat concave part is forewards, for taking hold more surely, and for lodging the tendons of the flexor muscles.——The ligaments for keeping down these tendons are fixed to the angles that are between the convex and concave sides.

The bones of the first *phalanx* * of the fingers answer to the description of the second bone of the thumb: only that the cavity in their base is not so oblong; nor is their motion on the metacarpal bones so much confined: for they can be moved laterally or circularly, but have no rotation or a very small degree of it round their axis.

Both the ends of this first *phalanx* are in a cartilaginous state at the birth; and the upper

‡ Scytalidæ, internodia, scuticula, agmina, acies, condyli articuli.

* Πρωτοφάλαγξ.

per one is afterwards affixed in form of an *epiphyse*.

The second bone * of the fingers has its base formed into two lateral cavities, and a middle protuberance; while the lower end has two lateral protuberances and a middle cavity; therefore it is joined at both ends in the same manner, which none of the bones of the thumb are.

This bone is in the same condition with the former in children.

The third bone † differs nothing from the description of the third bone of the thumb, excepting in the general distinguishing marks; and therefore the second and third *phalanx* of the fingers enjoy only flection and extension.

The upper end of this third *phalanx* is a cartilage in a ripe child; and is only an *epiphyse* after, till the full growth of the body.

All the difference of the *phalanges* of the several fingers consists in their magnitude.—— The bones of the *middle finger* ‡ being the longest and largest, —— those of the *fore-finger* ‖ come next to that in thickness, but not in length, for those of the *ring-finger* ** are a little longer. The *little finger* †† has the smallest

* Κονδυλοι.

† Μεταικονδυλοι, ριζαναχια.

‡ Καταπυγων, οφακελος, infamis, impudicus, verpus, famosus, obscænus.

‖ Δεατικος, indicator, λιχανος, demonstrativus, salutaris.

** Ἰατρικος, παραμεσος, δακτυλιώτης, επιβατης, annularis, medicus, cordis, digitus.

†† Μυοψ, ωτίτης, auricularis, minimus.

ſmalleſt bones. Which diſpoſition is the beſt contrivance for holding the largeſt bodies; becauſe the longeſt fingers are applied to the middle largeſt periphery of ſuch ſubſtances as are of a ſpherical figure (*a*).

The uſes of all the parts of our *ſuperior extremities* are ſo evident in the common actions of life, that it is needleſs to enumerate them here; and therefore I ſhall proceed to the laſt part of the ſkeleton. Only, leſt I ſhould ſeem to have forgot the ſmall bones at the joints of the hand, I deſire now to refer to the deſcription of them, under the common title of *ſeſamoid bones*, which I have placed after the bones of the feet.

OF THE INFERIOR EXTREMITIES.

THE *INFERIOR EXTREMITIES* depend from the *acetabula* of the *oſſa innominata*; are commonly divided into three parts, viz. the thigh, leg, and foot.

The *THIGH** has only one bone; which is the longeſt of the body, and the largeſt and ſtrongeſt of any of the cylindrical bones. The ſituation of it is not perpendicular: for the lower end is inclined conſiderably inwards; ſo that the knees are almoſt contiguous, while there is a conſiderable diſtance between the thigh-bones above: which is of good uſe to us, ſince ſufficient ſpace is thereby left for the external parts of gene-

(*a*) Galen de uſu part. lib. 1. cap. 24.

* Μηρος, femen, coxa, agis, anchæ os, crus, femur.

generation, the two great *cloacæ* of urine and *fæces*, and for the large thick muſcles that move the thigh inwards: and at the ſame time this ſituation of the thigh-bones renders our progreſſion quicker, ſurer, ſtreighter, and in leſs room; for had the knees been at a greater diſtance from each other, we muſt have been obliged to deſcribe ſome part of a circle with the trunk of our body in making a long ſtep, and, when one leg was raiſed from the ground, our center of gravity would have been too far from the baſe of the other, and we ſhould conſequently have been in hazard of falling; ſo that our ſteps would neither have been ſtreight nor firm; nor would it have been poſſible to walk in a narrow path, had our thigh-bones been otherwiſe placed. In conſequence, however, of the weight of the body bearing ſo obliquely on the joint of the knee, by this ſituation of the thigh-bones, weak ricketty children become in-knee'd.

The upper end of the thigh-bone is not continued in a ſtreight line with the body of it, but is ſet off obliquely inwards and upwards; whereby the diſtance here between theſe two bones at their upper part is conſiderably increaſed——This end is formed into a large ſmooth round head*, which is the greater portion of a ſphere unequally divided.—Towards its lower internal part a round rough ſpongy pit is obſervable, where the ſtrong ligament, commonly, but unjuſtly, called the *round* one, is fixed, to be extended from thence to the lower internal

* Vertebrum.

internal part of the receiving cavity, where it is conſiderably broader than near to the head of the thigh bone.———The ſmall part below the head, called the *cervix*, of the *os femoris*, has a great many large holes into which the fibres of the ſtrong ligament, continued from the capſular, enter, and are thereby ſurely united to it; and round the root of the neck, where it riſes from the bone, a rough ridge is found, where the capſular ligament of the articulation itſelf is connected.———Below the back-part of this root, the large unequal protuberance called *trochanter major* ‡, ſtands out; the external convex part of which is diſtinguiſhed into three different ſurfaces, whereof the one on the fore-part is ſcabrous and rough, for the inſertion of the *glutæus minimus*; the ſuperior one is ſmooth, and has the *glutæus medius* inſerted into it; and the one behind is made flat and ſmoooth by the tendon of the *glutæus maximus* paſſing over it.—The upper edge of this proceſs is ſharp and pointed as its back-part, where the *glutæus medius* is fixed; but forewards it is more obtuſe, and has two ſuperficial pits formed in it: Into the ſuperior of theſe, the *piriformis* is implanted; and the *obturator internus* and *gemini* are fixed into the lower one.—— From the backmoſt prominent part of this great *trochanter*, a rough ridge runs backwards and downwards, into which the *quadratus* is inſerted.———In the deep hollow, at the internal upper ſide of this ridge, the *obturator externus* is implanted.——

More

‡ Τροχάω, rotator natis, malum granatum teſticulorum.

More internally, a conoid proceſs, called *trochanter minor* *, riſes for the inſertion of the *muſulus pſoas*, and *iliacus internus*, and the *pectineus*, is implanted into a rough hollow below its internal root.——The muſcles inſerted into theſe two proceſſes being the principal inſtruments of the rotatory motion of the thigh, have occaſioned the name of *trochanters* to the proceſſes.——The tendons that are fixed into or paſs over the great *trochanter*, cauſe bruiſes by falls on this part to be attended with great pain and weakneſs of the limb, which generally remain long.

The body of the *os femoris* is convex on the fore-part, and made hollow behind, by the action of the muſcles that move it and the leg, and for the conveniency of ſitting, without bearing too much on theſe muſcles; and probably the weight of the legs depending from the thighs in that poſture contributes to this curvature.——The fore-part of the thigh-bone is a little flatted above by the beginning of the *cruræus* muſcle, as it is alſo below by the ſame muſcle and the *rectus*.——Its external ſurface is likewiſe made flat below by the *vaſtus externus*, where it is ſeparated from the former by an obtuſe ridge.——The *vaſtus internus* depreſſes a little the lower part of the internal ſurface ——The poſterior concave ſurface has a ridge riſing in its middle commonly called *linea aſpera*, into which the *triceps* is inſerted, and the ſhort head of the *biceps flexor tibiæ* riſes from it.——At the upper part of it the medullary veſſels enter by a ſmall hole that

* Rotator minor.

that runs obliquely upwards.—A little above which there is a rough *fossa* or two, where the tendon of the *glutæus maximus* is fixed.——— The lower end of the *linea aspera* divides into two, which descend towards each side.—The two *vasti* muscles have part of their origin from these ridges; and the long tendon of the *triceps* is fixed to the internal, by means of part of the *fascia aponeurotica* of the thigh. ——Near the beginning of the internal ridge, there is a discontinuation of the ridge, where the crural artery passes through the *aponeurosis*. —Between these two rough lines, the bone is made flat by the large blood-vessels and nerves which pass upon it; and near the end of each of these ridges, a small smooth protuberance may often be remarked, where the two heads of the external *gastrocnemius* muscle take their rise, and where sesamoid bones are sometimes found (*a*); and from the fore-part of the internal tubercle, a strong ligament is extended to the inside of the *tibia*.

The lower end of the *os femoris* is larger than any other part of it, and is formed into a great protuberance on each side, called its *condyles*; between which a considerable cavity is found, especially at the back part, in which the crural vessels and nerves lie immersed in fat.———The internal condyle is longer than the external, which must happen from the oblique position of this bone, to give less obliquity to the leg ——Each of these processes seems to be divided in its plain smooth surface. The mark of division on the external

(*a*) Vesal. lib. 1. cap. 28. & 30.

nal is a notch, and on the internal a small protuberance. The fore-part of this division, on which the *rotula* moves, is formed like a pulley, the external side of which is highest.—— Behind, there are two oblong large heads, whose greatest extent is backwards, for the motion of the *tibia*; and from the rough cavity between them, but near to the base of the internal condyle, the strong ligament commonly called the *cross* one, has its rise.——A little above which a rough protuberance gives insertion to the tendon of the *triceps*.—— The condyles, both on the outer and inner side of the knee are made flat by the muscles passing along them.—On the back-part of the internal, a slight depression is made by the tendons of the *gracilis* and *sartorius*; and on the external such another is formed by the *biceps flexor cruris*; behind which a deep *fossa* is to be observed, where the *poplitæus* muscle has its origin.——From the tubercle immediately before this cavity, a strong round ligament goes out to the upper part of the *fibula*.—— Round this lower end of the thigh bone, large holes are found, into which the ligaments for the security of the joint are fixed, and blood-vessels pass to the internal substance of the bone.

All the processes of the *femur* are cartilaginous in new-born children, and afterwards become small *apophyses*, with large *epiphyses*.

The thigh-bone being articulated above with the *acetabulum* of the *ossa innominata*, which affords its round head a secure and extensive play

play, can be moved to every ſide; but is reſtrained in its motion outwards, by the high brims of the cavity, and by the *round* ligament; for otherwiſe the head of the bone would have been frequently thruſt out at the breach of the brims on the inſide, which allows the thigh to move conſiderably inwards. ——————The body of this bone enjoys little or no rotatory motion, though the head moſt commonly moves round its own axis; becauſe the oblique progreſs of the neck and head from the bone is ſuch, that the rotatory motion of the head can only bring the body of the bone forewads and backwards: Nor is this head, as in the arm, ever capable of being brought to a ſtreight direction with its body; ſo far however as the head can move within the cavity backwards and forewards, the reſt of the bone may have a partial rotation.——— When the thigh bone reſiſts the actions of its muſcles more than the trunk of the body can then do, as in ſtanding, theſe muſcles have their effect on the trunk, cauſing it to bend foreward, raiſing it up, inclining it to the one or the other ſide, twiſting it obliquely, *&c.* which the rolling of the *acetabula* or the *oſſa innominata* on the round heads of the thigh-bones is well fitted for.———The *os femoris* is articulated below to the *tibia* and *rotula* in the manner afterwards to be deſcribed.

The nearneſs of the ſmall neck to the round head of the thigh bone, and its upper end being covered with very thick muſcles, make greater difficulty in diſtinguiſhing between a

luxation and fracture here, than in any other part of the body.

The *LEG* * is compoſed, acording to the common account, of two bones, *tibia* and *fibula*, though it ſeems to have a very good title to a third, the *rotula*; which bears a ſtrong analogy to the *olecranon* of the *ulna*, and moves always with the other two.

TIBIA†, ſo called from its reſemblance to an old muſical pipe or flute, is the long thick triangular bone, ſituated at the internal part of the leg, and continued in almoſt a ſtreight line from the thigh-bone.

The upper end of the *tibia* is large, bulbous, and ſpongy, and is divided into two cavities, by a rough irregular protuberance‡, which is hollow at its moſt prominent part, as well as before and behind. The anterior of the two ligaments that compoſe the great *croſs* one, is inſerted into the middle cavity, and the depreſſion behind receives the poſterior ligament.——The two broad cavities at the ſides of this protuberance are not equal; for the internal is oblong and deep, to receive the internal *condyle* of the thigh-bone: while the external is more ſuperficial and rounder, for the external *condyle*.——— In each of theſe two cavities of a recent ſubject, a ſemilunar cartilage is placed, which is thick at its convex edge, and becomes gradually

* Κνημη crus, tibia.

† Περονηιον, συντονηιον, focile majus, arundo major, canna major, canna comeſtica cruris.

‡ Διαφυσις, ἐξοχη νευροχονδρωδης, tuber, tuberculum.

dually thinner towards the concave or interior edge.——The middle of each of these cartilages is broad, and the ends of them turn narrower and thinner, as they approach the middle protuberance of the *tibia*.——The thick convex edge of each cartilage is connected to the capsular and other ligaments of the articulation, but so near to their rise from the *tibia*, that the cartilages are not allowed to change place far; while the narrow ends of the cartilages becoming almost ligaments, are fixed at the insertion of the strong cross ligament into the *tibia*, and seem to have their substance united with it; therefore a circular hole is left between each cartilage and the ligament, in which the most prominent convex part of each condyle of the thigh-bone moves.——The circumference of these cavities is rough and unequal for the firm connection of the ligaments of the joint.——Immediately below the edge at its back-part, two rough flatted protuberances stand out: Into the internal, the tendon of the *semimembranosus* muscle is inserted; and a part of the cross ligament is fixed to the external.——On the outside of this last tubercle, a smooth slightly-hollowed surface is formed by the action of the *popliteus* muscle.

Below the fore-part of the upper end of the *tibia*, a considerable rough protuberance * rises, to which the strong tendinous ligament of the *rotula* is fixed.—On the internal side of this, there is a broad scabrous slightly-

* Ἀντικνημιον, anterior tuber.

hollowed surface, to which the internal long ligament of the joint, the *aponeurosis* of the *vastus internus*, and the tendons of the *semi-nervosus*, *gracilis*, and *sartorius*, are fixed.——The lowest part of this surface is therefore the place where the *tibia* ought to be sawed thro' in an amputation, so as not to have too long and troublesome a stump, and, at the same time, to preserve its motions, by saving the proper muscles.——Below the external edge of the upper end of the *tibia*, there is a circular flat surface, covered in a recent subject with cartilage, for the articulation of the *fibula*; ———between which and the anterior knob, there is a rough hollow from which the *tibialis anticus*, and *extensor digitorum longus*, take their origin.———From the smooth flat surface, a ridge runs obliquely downwards and inwards, to give rise to part of the *solæus*, *tibialis posticus*, and *flexor digitorum longus*, and insertion to the *aponeurosis* of the *semimembranosus* which covers the *poplitæus*, and to some of the external fibres of this last named muscle.——At the inside of this ridge an oblique plain surface is left, where the greatest part of the *musculus poplitæus* is inserted.——The remaining body of the *tibia* is triangular.——The anterior angle is very sharp, and is commonly called the *spine* or *shin* *. This ridge is not streight; but turns first inwards, then outwards, and lastly inwards again——The plain internal side is smooth and equal, being little subjected to the actions of muscles; but the

* Ακανθα, spina, crea, linea prima tibiæ, angulus acutus.

the external side is hollowed above by the *tibialis anticus*, and below by the *extensor digitorum longus* and *extensor pollicis longus*. ——The two angles behind these sides are rounded by the action of the muscles;—the posterior side comprehended between them is not so broad as those already mentioned, but is more oblique and flatted by the action of the *tibialis posticus* and *flexor digitorum longus*.—— Some way above the middle of the bone the internal angle terminates, and the bone is made round by the pressure of the *musculus solæus*.—Near to this, the passage of the medullary vessels is seen slanting obliquely downwards.

The lower end of the *tibia* is made hollow, but so as a small protuberance rises in the middle.——The internal side of this cavity, which is smooth, and, in a recent subject, is covered with cartilage, is produced into a considerable process, commonly named *malleolus internus* *; the point of which is divided by a notch, and from it ligaments are sent out to the foot.——We ought to observe here, that this internal *malleolus* is situated more forewards than the internal condyle of the upper end of this bone; which is necessary to be remembered in reducing a fracture of the leg (*a*).——The external side of this end of the tibia has a rough irregular semilunar ca-

* Σφυρόν, πεσον, talus, clavicula, clavilla interior, clavilla domestica.

(*a*) Winslow, Exposition anatomique, des os secs, sect. 365.

vity formed in it, for receiving the lower end of the *fibula*.——The posterior side has two lateral grooves, and a small middle protuberance. In the internal depression, the tendons of the *musculus tibialis posticus* and *flexor digitorum longus* are lodged; and in the external, the tendon of the *flexor longus pollicis* plays.——From the middle protuberance, ligamentous sheaths go out, for tying down these tendons.

The articulations and motions of the *tibia* shall be explained, after all the three bones of the leg are described.

Both the ends of the *tibia* are cartilages at birth, and become afterwards *epiphyses*.

*FIBULA** is the small long bone, placed on the outside of the leg, opposite to the external angle of the *tibia*; the shape of it is irregularly triangular.

The head of the *fibula* has a superficial circular cavity formed on its inside, which, in a recent subject, is covered with a cartilage, but so closely connected to the *tibia* by ligaments, as to allow only a small motion backwards and forewards.——This head is protuberant and rough on its outside, where a strong round ligament and the *musculus biceps* are inserted; and, below the back-part of its internal side, a tubercle may be remarked, that gives rise to the strong tendinous part of the *solæus* muscle.

The

* Παραχνήμιον, perone, focile minus, arundo minor, canna minor cruris, fura, radius.

The body of this bone is a little crooked inwards and backwards, which figure is owing to the actions of the muſcles; but is ſtill further increaſed by nurſes, who often hold children careleſsly by the legs.——The ſharpeſt angle of the *fibula* is forewards, on each ſide of which the bone is conſiderably but unequally depreſſed by the bellies of the ſeveral muſcles that riſe from, or act upon it; and, in old people, theſe muſcles make diſtinct ſinuoſities for themſelves.——The external ſurface of the *fibula* is depreſſed obliquely from above downwards and backwards, by the two *peronæi*.——Its internal ſurface is unequally divided into two narrow longitudinal planes, by an oblique ridge extended from the upper part of the anterior angle, to join with the lower end of the internal angle. To this ridge the ligament ſtretched between the two bones of the leg is connected.——The anterior of the two planes is very narrow above, where the *extenſor longus digitorum* and *extenſor longus pollicis* ariſe from it; but is broader below, where it has the print of the *nonus Veſalii*.——The poſterior plane is broad and hollow, giving origin to the larger ſhare of the *tibialis poſticus*.——The internal angle of this bone has a tendinous membrane fixed to it, from which fibres of the *flexor digitorum longus* take their riſe.——The poſterior ſurface of the *fibula* is the plaineſt and ſmootheſt, but is made flat above by the *ſolæus*, and is hollowed below by the *flexor pollicis longus*.——In the middle of this

this surface the canal for the medullary vessels may be seen slanting downwards.

I have taken particular notice of the entry and direction of the medullary vessels of the large bones of the extremities (*a*); because, in several chirurgical cases, a surgeon, who is ignorant of this, may do mischief to his patient. Thus, for example, if these vessels are opened very near to their entry into the bone, or while they are in the oblique passage through it, an obstinate hæmorrhagy may ensue: For the arteries being connected to the bony passage, styptics, and other like corrugators, are vainly applied; compressing instruments can do no service, and ligatures cannot be employed.— There seems to be a particular design in the contrivance of these canals; those in the *os humeri*, *tibia*, and *fibula*, running obliquely downwards from their external entry; whereas in the *radius*, *ulna*, and *os femeris*, they slant upwards, whereby the arteries and nerves which are sent into these three last bones, must suffer a considerable reflection before they come at the *cancelli*. The reason of this diversity may perhaps be, that the arteries which are so small within the bones as to have no strong contractile propelling force in their coats, and where they are not assisted by the action of any moving neighbouring organ, should have, at least in their passage through the bone, a favourable descent for their liquids: Which, it is evident, they have in the descending oblique passages formed for them in the first class of bones, to wit, the

os

(*a*) Havers, Osteolog. nov. disc. 1. p. 59.

os humeri, *tibia*, and *fibula* which are generally depending; and they also most frequently acquire the like advantage in the *radius*, *ulna*, and *os femoris*, because the hand, in the most natural posture, is higher than the elbow; and when we sit or lie, the lower end of the thigh bone comes to be at least as high raised as the upper. In standing and walking, or when the arms are moved, the blood must indeed ascend as it passes through the bones of the fore-arm and thigh; but the pressure of the muscles, then in action, on the vessels, before they enter the bones, is sufficient to compensate the disadvantage of their course. This reasoning seems to be still enforced, by observing, that this passage is always nearer the upper than the lower ends of these bones.

The lower end of the *fibula* is extended into a spongy oblong head, on the inside of which is a convex, irregular and frequently a scabrous surface, that is received by the external hollow of the *tibia*, and so firmly joined to it by a very thin intermediate cartilage and strong ligaments, that it scarce can move.—Below this, the *fibula* is stretched out into a coronoid process, that is smooth, covered with cartilage on its internal side, and is there contiguous to the outside of the first bone of the foot, the *astragalus*, to secure the articulation. This process, named *malleolus, externus*, being situated farther back than the internal *malleolus*, and in an oblique direction, obliges us naturally to turn the fore-part of the foot outwards

outwards (*a*). At the lower internal part of this proceſs, a ſpongy cavity for mucilaginous glands may be remarked; from its point ligaments are extended to the *aſtragalus*, *os ciacis*, and *os naviculare*, bones of the foot; and from its inſide ſhort ſtrong ones go out to the *aſtragalus*. On the back-part of it a ſinuoſity is made by the tendons of the *peronæi* muſcles.———When the ligament extended over theſe tendons from the one ſide of the depreſſion to the other is broke, ſtretched too much, or made weak by a ſprain, the tendons frequently ſtart forewards to the outſide of the *fibula*.

The conjunction of the upper end of the *fibula* with the *tibia* is by plain ſurfaces tipped with cartilage, and at its lower end the cartilage ſeems to glue the two bones together, not, however, ſo firmly in young people, but that the motion at the other end of ſuch a long *radius* is very obſerveable.—In old ſubjects I often ſee the two bones of the leg grown together at their lower ends.

The principal uſe of this bone is to afford origin and inſertion to muſcles; the direction of which may be a little altered on proper occaſions, by its upper part ſhuffling backwards and forewards.—It likewiſe helps to make the articulation of the foot more ſecure and firm. ——The ends of the *tibia* and *fibula* being larger than their middle, a ſpace is here left, which is filled up with ſuch another ligament as I deſcribed extended between the bones of the

(*a*) Winſlow, Memoires de l'acad. des ſciences, 1722

the fore-arm; and which is alſo diſcontinued at its upper part, where the *tibialis anticus* immediately adheres to the *ſolæus* and *tibialis poſticus*; but every where elſe it gives origin to muſcular fibres (*a*).

Both the ends of this bone are cartilaginous in a ripe child, and aſſume the form of *appendices* before they are united to its body.

ROTULA * is the ſmall flat bone ſituated at the fore part of the joint of the knee.——Its ſhape reſembles the common figure of the heart with its point downwards.——The anterior convex ſurface of the *rotula* is pierced by a great number of holes, into which fibres of the ſtrong ligament that is ſpread over it, enter.——Behind, its ſurface is ſmooth, covered with cartilage, and divided by a middle convex ridge into two cavities, of which the external is largeſt; and both are exactly adapted to the pulley of the *os femoris*, on which they are placed in the moſt ordinary unſtraining poſtures of the leg; but when the leg is much bended, the *rotula* deſcends far down on the condyles: and when the leg is fully extended, the *rotula* riſes higher, in its upper part, than the pulley of the thigh bone.——The plain ſmooth ſurface is ſurrounded by a rough prominent edge, to which the capſular ligament adheres.——Below, the point of the bone is ſcabrous, where the ſtrong tendinous ligament from the tubercle of the *tibia* is fixed.—The upper

(*a*) Weitbrecht, Syndeſmolog. p. 156.

* Ἐπιμυλις, μυλακρις, κόγχος, ἐπιγονατις, πλακουντοειδες, patella, mola, genu, ſcutiforme os, cartilaginoſum, diſciforme, oculus genu.

upper horizontal part of this bone is flatted and unequal, where the tendons of the extensors of the leg are inserted.

The substance of the *rotula* is cellular, with very thin external firm plates: But then these *cells* are so small, and such a quantity of bone is employed in their formation, that scarce any bone of its bulk is so strong. Besides, it is covered all over with a thick ligament, (as it was observed, that this sort of bones generally is), to connect its substance, and is moveable to one side or other; therefore is sufficiently strong to resist the ordinary actions of the large muscles that are inserted into it, or any common external force applied to it; while a fixed process, such as the *olecranon*, would not have been sufficient to bear the whole weight of our bodies, which frequently falls on it, and would have hindered the rotatory motion of the leg. Notwithstanding these precautions to preserve this bone from such injuries, yet I have seen a transverse fracture in it, when, by the report of the patient, and of the people about him, and by the want of swelling, discolouring, or other mark of bruise or contusion, it was plain the bone was broken by the violent straining effort of the muscles (*a*). Though my patient recovered the use of the joint of the knee, yet I think it reasonable to believe, that this sort of fracture is commonly attended with difficulty of motion, after the broken parts of the *rotula* are reunited; because the callous matter probably extends itself into the cavity of the joint, where it either grows to some of the

(*a*) See Ruysch. Observ. anat. chirurg. obs. 3.

parts or makes such an inequality on the surface of this bone, as does not allow it to perform the necessary motions on the condyles of the *femur**.

At the ordinary time of birth, the *rotula* is entirely cartilaginous, and scarcely assumes a bony nature so soon as most *epiphyses* do.

The parts which constitute the joint of the knee being now described, let us examine what are its motions, and how performed.——The two principal motions are flection and extension.——In the former of these, the leg may be brought to a very acute angle with the thigh, by the condyles of the thigh-bones being round and made smooth far backwards. In performing this the *rotula* is pulled down by the *tibia*.——When the leg is to be extended, the *rotula* is drawn upwards, consequently the *tibia* forewards by the *extensor* muscles; which, by means of the protuberant joint, and of this thick bone with its ligament, have in effect the chord, with which they act, fixed to the *tibia* at a considerable angle, therefore act with advantage; but are restrained from pulling the leg farther than to a streight line with the thigh, by the posterior part of the *cross* ligament, that the body might be supported by a firm perpendicular column: For at this time the thigh and leg are as little moveable in a rotatory way, or to either side, as if they were one continued bone.——But when the joint is a little bended, the *rotula* is not tightly braced, and the posterior ligament is relaxed; therefore this bone may be moved a little to either side, or with a small rotation in the superficial cavities of the *tibia*; which is done by the motion of the external cavity backwards and fore-

* Pare, liv. 15. cap. 22

wards, the internal ſerving as a ſort of axis (*a*). Seeing then one part of the *croſs* ligament is ſituated perpendicularly, and the poſterior part is ſtretched obliquely from the internal condyle of the thigh outwards, that poſterior part of the *croſs* ligament prevents the leg's being turned at all inwards; but it could not hinder it from turning outwards almoſt round, was not that motion confined by the lateral ligaments of this joint, which can yield little. This rotation of the leg outwards is of good advantage to us in croſſing our legs, and turning out feet outwards, on ſeveral neceſſary occaſions; tho' it is altogether fit this motion ſhould not be very large, to prevent frequent luxations here. While all theſe motions are performing, the part of the *tibia* that moves immediately on the condyles is only ſo much as is within the cartilaginous rings, which, by the thickneſs on their outſides, make the cavities of the *tibia* more horizontal, by raiſing their external ſide where the ſurface of the *tibia* ſlants downwards. By this means the motions of this joint are more equal and ſteady than otherwiſe they would have been. The cartilages being capable of changing a little their ſituation, are fit for doing this good office in the motions and poſtures of the member, and contribute to make the motions larger and quicker.

On account of the very large ſurface of the bones forming the joint of the knee, and the many ſtrong ligaments connecting them luxations ſeldom happen here. But theſe very ligaments, the *aponeuroſis* paſſing over this joint, the quantity of fat and mucilaginous glands neceſſary

(*a*) Winſlow, Expoſition anatomique du corps humain, traite des os ſecs, §. 976.

ceſſary for lubricating it, make it more ſubject to *white-ſwellings*, dropſies, and ſuch other diſorders, than any other joint of the body.

The *FOOT* is divided, as well as the hand, into three parts, *viz. tarſus*, *metatarſus*, and *toes*: In the deſcription of which, the ſeveral ſurfaces ſhall be named, according to their natural ſituation, *viz.* the *bread* of the foot, ſhall be called ſuperior; the ſole, inferior; the ſide on which the great toe is, internal; that where the little toe is, external.

The *tarſus* conſiſts of ſeven ſpongy bones; to wit, the *aſtragalus*, *os calcis*, *naviculare*, *cuboides*, *cuneiforme externum*, *cuneiforme medium*, and *cuneiforme internum*.

The *aſtragalus* is the uppermoſt of theſe bones.—The *os calcis* is below the *aſtragalus*, and is conſiderably prominent backwards beyond the other bones to form the heel.—The *os naviculare* is in the middle of the internal ſide of the *tarſus*.—The *os cuboides* is the moſt external of the row of four bones at its fore-part.—The *os cuneiforme externum* is placed at the inſide of the *cuboid*.—The *cuneiforme medium* is between the *external* and *internal cuneiform* bones, and the *internal cuneiform* is put at the internal ſide of foot.

That the deſcription of theſe bones may not be immoderately ſwelled with repetition, I deſire, once for all, to obſerve, That wherever a ridge is mentioned, without a particular uſe aſſigned, a ligament is underſtood to be fixed to it; or where a ſpongy rough cavity, depreſſion, or *foſſa* is remarked, without naming its uſe, a ligament is inſerted, and mucilaginous glands are lodged: For ſuch will occur in the detail of each of theſe bones.

The upper part of the *aſtragalus* † is formed into a large ſmooth head ‡, which is ſlightly hollowed in the middle; and therefore reſembles a ſuperficial pulley, by which it is fitted to the lower end of the *tibia*.——The internal ſide of this head is flat and ſmooth, to play on the internal *malleolus*———The external ſide has alſo ſuch a ſurface, but larger, for its articulation with the external *malleolus*.—Round the baſe of this head there is a rough *foſſa*; and, immediately before the head, as alſo below its internal ſmooth ſurface, we find a conſiderable rough cavity.

The lower ſurface of the *aſtragalus* is divided by an irregular deep rough *foſſa*; which at its internal end is narrow, but gradually widens, as it ſtretches obliquely outwards and forewards.—The ſmooth ſurface, covered with cartilage, behind this *foſſa*, is large, oblong, extended in the ſame oblique ſituation with the *foſſa*, and concave, for its conjunction with the *os calcis*.——The back part of the edge of this cavity is produced into two ſharp-pointed rough proceſſes, between which is a depreſſion made by the tendon of the *flexor pollicis longus*.——The lower ſurface before the *foſſa* is convex, and compoſed of three diſtinct ſmooth planes. The long one behind, and the exterior or ſhorteſt, are articulated with the heel-bone; while the internal, which is the moſt convex of the three, reſts and moves upon a cartilaginous ligament, that is continued from the *calcaneum* to the *os ſcaphoides*. Without which ligament, the *aſtragalus*

† Ἀστραγος, talus, baliſtæ os, malleolus, chaib, quatrio, os teſſaræ, clavicula, nucifrme.

‡ Τετραγωνος.

ſtragalus could not be ſuſtained, but would be preſſed out of its place by the great weight it ſupports, and the other bones of the *tarſus* would be ſeparated. Nor would a bone be fit here, becauſe it muſt have been thicker than could conveniently be allowed; otherwiſe it would break, and would not prove ſuch an eaſy bending baſe, to leſſen the ſhock which is given to the body in leaping, running, &c.

The fore-part of this bone is formed into a convex oblong ſmooth head, called byſome its proceſs, which is received by the *os naviculare*. Round the root of this head, eſpecially on the upper ſurface, a rough *foſſa* may be remarked.

The *aſtragalus* is articulated above to the *tibia* and *fibula*, which together form one cavity. Though, in this articulation, the bones have prominencies and cavities ſo ſmall, as might allow motions in all directions; yet the flection and extenſion are the moſt conſiderable, the other motions being confined by the *malleoli*, and by the ſtrong ligaments which go out from the points of theſe proceſſes to the *aſtragalus* and *os calcis*.—When the foot is bended, ſo far as it is commonly when we ſtand, no lateral or rotatory motion is allowed in this joint; for then the head of the *aſtragalus* is ſunk deep between the *malleoli*, and the ligaments are tenſe; but when the foot is extended, the *aſtragalus* can move a little to either ſide, and with a ſmall rotation. By this contrivance the foot is firm, when the weight of the body is to be ſupported on it; and when a foot is raiſed, we are at liberty to direct it more exactly to the place we intend next to ſtep upon.—The *aſtragalus* is joined below, to the *os calcis*; and before, to the *os naviculare*, in the manner to

be explained, when these bones are described.

A considerable share of this bone is ossified in a new born infant.

Calcaneum * is the largest bone of the seven. ——Behind, it is formed into a large knob, commonly called the *heel:* The surface of which is rough behind, where the *tendo Achillis* is inserted into it; and above, it is hollow and spongy. Farther forewards, on the upper surface of the *calcaneum*, there is an irregular oblong smooth convexity, adapted to the concavity at the back part of the *astragalus:* And beyond this a narrow *fossa* is seen, which divides it from two small concave smooth surfaces, that are joined to the fore-part of the *astragalus.*—— Behind the posterior of these smooth surfaces, which is the largest, a small sinuosity is made by the tendon of the *flexor digitorum longus:* at the fore part of which a small rough protuberance appears, that gives rise to the *musculus extensor digitorum brevis.*

The external side of this bone is flat, with a superficial *fossa* running horizontally, in which the tendon of the *musculus peronæus longus* is lodged.——The internal side of the heel-bone is hollowed, for lodging the origin of the *massa cornea Jac. Sylvii*, and for the safe passage of tendons, nerves, and arteries. ——Under the side of the internal smooth concavity, a particular groove is made by the tendon of the *flexor pollicis longus;* and from the thin protuberance on this internal side, the cartilaginous ligament that supports the *astragalus*, goes out to the *os naviculare;* on which ligament, and on the edge of this bone to which it is fixed, the groove is formed for the tendon

* Os calcis, πτέρνα, calcar pedis.

tendon of the *flexor digitorum profundus*.

The lower ſurface of this bone is preſſed flat at the back-part, by the weight of our bodies; and immediately before this plane, there are two tubercles, from the internal of which the *muſculus abductor pollicis*, *flexor digitorum ſublimis*, as alſo part of the *aponeuroſis plantaris*, and of the *abductor minimi digiti*, have their origin; and the other part of the *abductor minimi digiti* and *aponeuroſis plantaris* riſes from the external.———Before theſe protuberances this bone is concave, for lodging the flexor muſcles; and at its fore-part we may obſerve a rough depreſſion, from which, and a tubercle behind it, the ligament goes out that prevents this bone to be ſeparated from the *os cuboides*.

The fore-part of the *os calcis* is formed into an oblong pulley-like ſmooth ſurface, which is circular at its upper external end, but is pointed below. This ſmooth ſurface is fitted to the *os cuboides*.

Though the ſurfaces by which the *aſtragalus* and *os calcis* are articulated, ſeem fit enough for motion; yet the very ſtrong ligaments by which theſe bones are connected, prevent it, and render this principal part of our baſe, which reſts on the ground, *to wit*, the *os calcis*, firm.

A large ſhare of the heel-bone is offified at the ordinary time of birth, and the large knob appears afterwards in form of an *epiphyſe*.

Os naviculare *, is ſomewhat circular.——It is formed into an oblong concavity behind for receiving the anterior head of the *aſtragalus*.———On the upper ſurface there is a rough *foſſa*.———Below, the *os naviculare* is very unequal and rough; but hollow for the

* Σκαφοειδης, os cymbæ.

the safety of the muscles.——On its inside a large knob rises out, from which the *abductor pollicis* takes in part its origin, the tendon of the *tibialis posticus* is inserted into it, and to it two remarkable ligaments are fixed; the first is the strong one, formerly mentioned, which supports the *astragalus*; the second is stretched from this bone obliquely cross the foot, to the metatarsal bones of the middle toe, and of the toe next to the little one.——On the outside of the *os naviculare* there is a semicircular smooth surface, where it is joined to the *os cuboides*.——The fore-part of this bone is all covered with cartilage, and is divided into three smooth planes, fitted to the three *ossa cuneiformia*.

The *os naviculare* and *astragalus* are joined as a ball and socket, and the *naviculare* moves in all directions in turning the toes inwards, or in raising or depressing either side of the foot; though the motions are greatly restrained by the ligaments which connect this to the other bones of the *tarsus*.—A weakness of these ligaments causes sometimes an unnatural turn of the fore-part of the foot inwards.

The *os naviculare* is wholely cartilaginous in a new-born infant.

*OS CUBOIDES** is a very irregular cube.——Behind, it is formed into an oblong unequal concavity, adapted to the fore-part of the *os calcis*.——On its internal side, there is a small semicircular smooth cavity, to join the *os naviculare*.—Immediately before which, an oblong smooth plane is made by the *os cuneiforme externum*.——Below this the bone is hollow

* Πολυμορφον, cubiforme, quadratum, grandinosum, varium, tessaræ, multiforme.

hollow and rough.——On the internal side of the lower surface, a round protuberance and *fossa* are found, where the *musculus abductor pollicis* has its origin. On the external side of this same surface, there is a round knob, covered with cartilage; immediately before which, a smooth *fossa* may be observed, in which the tendon of the *peronæus primus* runs obliquely cross the foot; and on the knob, the thin flat cartilage proper to this muscle plays; in place of which sometimes a bone is found: More externally than the knob, a rough hollow ismade, for the strong ligaments stretched bewixt this bone and the *os calcis*.——Before, the surface of the *os cuboides* is flat, smooth and slightly divided into two planes, for sustaining the *os metatarsi* of the little toe, and of the toe next to it.

The form of the back-part of the *os cuboides*, and the ligaments connecting the joint there with the *os calcis*, both concur in allowing little motion in this part.

The offification of this bone is scarcely begun at the birth.

Os cuneiforme externum *, if we regard its situation or *medium* by its bulk, is much of the shape of a wedge, being broad and flat above, with long sides running obliquely downwards, and terminating in a sharp edge.——The upper surface of this bone is an oblong square.——The one behind is nearly a triangle, but not compleat at the inferior angle, and is joined to the *os naviculare*.—The external side is an oblong square divided as it were by a diagonal; the upper half of it is smooth, for its conjunction with the *os cuboides*: The other is

* Chalcoideum externum.

is a scabrous hollow, and in its superior anterior ancle a small smooth impression is made by the *os metatarsi* of the toe next to the little one.—The internal side of this bone is also quadrangular with the fore-part of its edge made flat and smooth by the *os metatarsi* of the toe next to the great one, and the back part is also flat and smooth where the *os cuneiforme medium* is contiguous to it.——The fore part of this bone is an oblong triangle, for sustaining the *os metatarsi* of the middle toe.

Os cuneiforme medium, or *minimum*, is still more exactly the shape of a wedge than the former.——Its upper part is square;—its internal side has a flat smooth surface above and behind, for its conjunction with the following bone; with a small rough *fossa* below; and a considerable share of it is rough and hollow.—The external side is smooth and a little hollowed, where it is contiguous to the last described bone.—Behind, this bone is triangular, where it is articulated with the *os naviculare*; and it is also triangular at its fore part, where it is contiguous to the *os metatarsi* of the toe next to the great one.

Os cuneiforme maximum or *internum*, differs from the two former in its situation, which is more oblique than theirs.—Besides, its broad thick part is placed below, and the small thin point is above and outwards; while its under broad surface is concave, for allowing a safe passage to the flexors of the great toe.——The surface of this *os cuneiforme* behind, where it is joined to the *os naviculare*, is hollow, smooth, and of a circular figure below, but pointed above.—The external side consists of two smooth

and

and flat surfaces, whose direction is nearly at right angles with each other. With the posterior, that runs obliquely from below forewards and upwards, the *os cuneiforme minimum* is joined; and with the anterior, whose direction is longitudinal, the *os metatarsi* of the toe next to the great one is connected.——The forepart of this bone is semilunar, but flat and smooth, for sustaining the *os metatarsi* of the great toe.——The internal side is scabrous, with two remarkable tubercles below, from which the *musculus abductor pollicis* rises, and the *tibialis anticus* is inserted into its upper part.

The three cuneiform bones are all so secured by ligaments, that very little motion is allowed in any of them, and they are cartilaginous in a *fœtus* of nine months.

These seven bones of the *tarsus*, when joined, are convex above, and leave a concavity below, for lodging safely the several muscles, tendons, vessels, and nerves that lye in the sole of the foot.—In the recent subject, their upper and lower surfaces are covered with strong ligaments which adhere firmly to them, and all the bones are so tightly connected by these and the other ligaments, which are fixed to the rough ridges and *fossæ* mentioned in the preceeding description of the particular bones, that, notwithstanding the many surfaces covered with cartilage, some of which are of the form of the very moveable articulations, no more motion is here allowed, than only to prevent too great a shock of the fabric of the body in walking, leaping, &c. by falling on too solid a base; which, if it was one continued bone, would likewise be much more liable to be broken: and in order to make our foot accommodate itself to the

the surfaces we tread on, by becoming more or less hollow, or by raising or depressing either side of it, as might be judged by what was said of the particular bones.

Sprains here occasion, as in the wrist, great pain and obstinate tumours, which too often cause carious bones.

METATARSUS * is composed of five bones, which, in their general characters, agree with the metacarpal bones; but may be distinguished from them by the following marks: 1. They are longer, thicker, and stronger. 2. Their anterior round ends are not so broad, and are less in proportion to their bases. 3. Their bodies are sharper above and flatter on the sides, with their inferior ridge inclined more to the outside. 4. The tubercles at the lower parts of the round head are larger.

The first or internal metatarsal bone is easily distinguished from the rest by its thickness.—The one next to it is the longest, and with its sharp edge almost perpendicular.——The others are shorter and more oblique, as their situation is more external. Which general remarks, with the description I am now to give of each, may teach us to distinguish them from each other.

Os metatarsi pollicis is by far the thickest and strongest, as having much the greatest weight to sustain. Its base is oblong, irregularly concave, and of a semilunar figure, to be adapted to the *os cuneiforme maximum*.——The inferior edge of this base is a little prominent and rough, where the tendon of the *peronæus primus* muscle is inserted.—On its outside an oblique circular depression is made by the second meta-

* Στῆθος, πεδίον, planta, planum, vestigium, solium, pectus, præcordium, pectusculum.

metatarsal bone.—— Its round head has generally on its fore-part a middle ridge, and two oblong cavities, for the *ossa sesamoidea*; and on the external side a depression is made by the following bone.

Os metatarsi of the second toe, is the longest of the five, with a triangular base supported by the *os cuneiforme medium* and the external side produced into a process; the end of which is an oblique smooth plane, joined to the *os cuneiforme externum.*——————Near the internal edge of the base, this bone has two small depressions, made by the *os cuneiforme maximum*, between which is a rough cavity. —Farther forewards we may observe a smooth protuberance, which is joined to the foregoing bone.——On the outside of the base are two oblong smooth surfaces, for its articulation with the following bone; the superior smooth surface being extended longitudinally, and the inferior perpendicularly; between which there is a rough *fossa*

Os metatarsi of the middle toe, is the second in length.—Its base, supported by the *os cuneiforme externum*, is triangular, but slanting outwards, where it ends in a sharp-pointed little process; and the angle below is not compleated.

The internal side of this base is adapted to the preceeding bone; and the external side has also two smooth surfaces covered with cartilage, but of a different figure; for the upper one is concave, and, being round behind, turns smaller as it advances forewards; and the lower surface is little, smooth, convex, and very near the edge of the base.

Os metatarsi of the fourth toe, is near as long as the former, with a triangular slanting

baſe joined to the *os cuboides*, and made round at its external angle, having one hollow ſmooth ſurface on the outſide, where it is preſſed upon by the following bone, and two on the internal ſide, correſponding to the former bone; behind which is a long narrow ſurface impreſſed by the *os cuneiforme externum*.

Os metatarſi of the little toe, is the ſhorteſt, ſituated with its two flat ſides above and below, and with the ridges laterally.——The baſe of it, part of which reſts on the *os cuboides*, is very large, tuberous, and produced into a long-pointed proceſs externally, where part of the *abductor minimi digiti* is fixed; and into its upper part the *peronæus ſecundus* is inſerted.—— Its inſide has a flat conoidal ſurface, where it is contiguous to the preceeding bone.

When we ſtand, the fore-ends of theſe metatarſal bones, and the *os calcis*, are our only ſupporters; and therefore it is neceſſary theyſhould be ſtrong, and ſhould have a confined motion.

The bones of the *TOES* are much a-kin to thoſe of the thumb and fingers; particularly the two of the great toe are preciſely formed as the two laſt of the thumb; only their poſition, in reſpect of the other toes, is not oblique; and they are proportionally much ſtronger, becauſe they are ſubjected to a greater force; for they ſuſtain the force with which our bodies are puſhed forewards by the foot behind at every ſtep we make; and on them principally the weight of the body is ſupported, when we are raiſed on our tiptoes.

The three bones in each of the other four toes, compared to thoſe of the fingers, differ from them in theſe particulars.——They are leſs, and ſmaller in proportion to their lengths:

——Their

——— Their baſes are much larger than their anterior ends: Their bodies are more narrow above and below, and flatter on the ſides.——— The firſt *phalanx* is proportionally much longer than the bones of the ſecond and third, which are very ſhort.

Of the four, the toe next to the great one, has the largeſt bones in all dimenſions, and more externally the toes are leſs.——The little toe, and frequently that next to it, have the ſecond and third bones intimately united into one; which may be owing to their little motion and the great preſſure they are ſubjected to.

The toes are of good uſe to us in walking: for, when the ſole is raiſed, they bring our body, with its center of gravity, perpendicular to the advanced foot.

The bones of the *metatarſus* and toes, are in the ſame condition in children as thoſe of the *metacarpus* and fingers.

The only bones now remaining to complete the deſcription of the ſkeleton, are the ſmall ones, which are found at the joints of the fingers and toes, and in ſome other parts, called *OSSA SESAMOIDEA*, which are of very different figures and ſizes, though they are generally ſaid to reſemble the ſeed of the *ſeſamum*.——They ſeem to me nothing elſe than the ligaments of the articulations or the firm tendons of ſtrong muſcles, or both, become bony, by the compreſſion which they ſuffer. Thus the *ſeſamoid* bones at the beginning of the *gaſtrocnemii* muſcles, are evidently compoſed of the tendinous fibres only.——Theſe, at the firſt joint of the great toe, are as plainly the ſame continued ſubſtance with the ligaments

and the tendons of the *adductor*, *flexor*, *brevis*, and *abductor*.——That which is sometimes double at the second joint of that toe, is part of the capsular ligament; and if we enumerate the other *sesamoid* bones that are at any time found, we may observe all of them formed in this manner.—Their number, figure, situation, and magnitude, are so uncertain, that it were in vain to insist on the differences of each; and therefore I shall only in general remark,

1. That where ever the tendons and ligaments are firmest, the actions of the muscles strongest, and the compression greatest, there such bones are most commonly found.

2. That, *cæteris paribus*, the older the subject is in which they are sought, their number is greater, and their size is larger.

3. The more labour any person is inured to, he has, *cæteris paribus*, the most numerous and largest *ossa sesmoidea*.

However, as the two at the first joint of the great toe are much larger than any other, are early formed, and are seldom wanting in an adult, we may judge, that besides the more forcible cause of their formation, there should also be some particular advantage necessary at this place, rather than elsewhere, which may possibly be, to allow the *flexor* muscles to send their tendons along this joint, secure from compression in the hollow between the two oblong sesamoid bones; while, by removing these tendons from the center of motion, and giving them the advantage of an angle at their insertion, the force of the muscles is increased, and therefore the great superincumbent weight of our body in progression is more easily raised.

APPEN

APPENDIX.

Of the Marks of a FEMALE SKELETON.

TO finiſh the deſcription of the bones, is generally to conclude the *oſteology*; but that no part of the ſubject may be left untouched, I think it neceſſary to ſubjoin the diſtinguiſhing marks of the male and female ſkeletons; and have choſen to illuſtrate them principally in the latter; becauſe women having a more delicate conſtitution, and affording lodging and nouriſhment to their tender *fœtuſes*, till they have ſufficient ſtrength and firmneſs to bear the injuries of the atmoſphere, and contact of other more ſolid ſubſtances, their bones are frequently incomplete, and always of a make in ſome parts of the body different from thoſe of the robuſt male; which agree to the deſcription already given, unleſs where the proper ſpecialities of the female were particularly remarked; which could not be done in all places where they occur, without perplexing the order of this treatiſe: Therefore I choſe rather to ſum them up here by way of *Appendix*.

The cauſes of the following ſpecialities of the female bones may be reduced to theſe three: 1. A weak lax conſtitution. 2. A ſedentary unactive life, increaſing that conſtitution. 3. A proper frame for being mothers.

The bones of women are ſmaller in proportion to their length than thoſe of men; becauſe the force of their muſcles is not ſo great, nor is ſuch ſtrong external force applied to them to prevent their ſtretching out in length.

The depreſſions, ridges, ſcabrous ſurfaces, and other inequalities made by the muſcles, are not ſo conſpicuous in them; becauſe their muſcles are neither ſo thick nor ſtrong, nor ſo much employed, to make ſo ſtrong prints on their bones.

Their *os frontis* is more frequently divided by a continuation of the *ſagittal* future, which depends on the firſt and ſecond general cauſes aſſigned above, for the ſpecialities in their bones; as will appear after reflecting on the account given formerly of the middle internal ſpine of this bone.

Their *clavicles* are leſs crooked; becauſe their arms have been leſs forcibly pulled forewards, which in our *European* women, eſpecially thoſe of diſtinction, is more hindered by their garb.

Their *ſternum* is more raiſed by long cartilages below, that the *thorax* might be there widened in ſome proportion to what it is ſhortened by the preſſure upon the *diaphragm*, when they are with child.

The defect of bone, or the hole in the middle of the *ſternum*, is oftenеſt found in them, to allow the paſſage of the mammary veſſels, ſay ſome; but, in my opinion, this is owing to a lax conſtitution, by which the oſſification is not ſo ſoon compleated as in men, where the action of the ſolids is vigorous, and the circulation of the fluids is briſk; for a much

much ſmaller hole might have ſerved this purpoſe; and the branches of the internal mammary veſſels which are ſent to the external parts of the *thorax*, do not paſs here, but between the cartilages of the ribs, before theſe are joined to the *ſternum*.

The *cartilago xiphoides*, is oftener bifurcated in women than men, for the reaſon aſſigned in the preceeding paragraph, *viz.* a leſs forcible power of offification.

The ſuperior cartilages of the ribs ſooner oſſify, to ſupport the weight of the *mammæ*.

The middle cartilages are more flat and broad by the weight of the breaſts.

The inferior cartilages are longer, for enlarging the cheſt.

Weak women who have born many children when young, often have the *vertebræ* of their back bended forewards, and their *ſternum* depreſſed, or become round ſhouldered and flat breaſted (*a*) by the preſſure and weight of the impregnated *uterus*, and by the ſtrong action of the abdominal muſcles.

The *os ſacrum* is broader and turned much more backwards, for enlarging the *pelvis*.

The *os coccygis* is more moveable, and much leſs bended forewards, to facilitate the birth.

The *oſſa ilium* are more hollow, and more reflected outwards, and conſequently further removed from each other, in order to widen the lower part of their *abdomen*, and for the better ſupport of the impregnated *uterus*.

The ridge on the upper part of the *oſſa pubis*, is

(*a*) Cheſelden, Anatomy, book 1. chap. 3.

is larger in ſuch women as have born children, being extended by the ſtrong action of the *muſculi recti abdominis*.

The cartilage between the two *oſſa pubis*, eſpecially in women who have born children, is thicker than in men, by which the *pelvis* is more capacious in females.

The conjoined ſurfaces of the *oſſa pubis*, and of the *oſſa innominata* and *ſacrum* are leſs, the angle under the *ſymphyſis* of the *oſſa pubis*, is much larger, and the arches formed below and behind by the *oſſa ilium* and *iſchium* are wider, which, with the ſtreighter *os ſacrum*, and more diſtant *tubera iſchii*, leave a larger paſſage for the excluſion of the child in birth.

The great tuberoſity of the *oſſa iſchium*, is flatter in women than in men, becauſe it is more preſſed upon in the ſedentary life which females enjoy.

In conſequence of the *pelvis* of women being wider, the articulations of their thigh-bones muſt be farther removed from each other: and therefore a larger ſpace is left for the procreation and birth of children (*a*); which diſtance of the thighs, may be one reaſon why women in running generally ſhuffle more from one ſide to the other than men, to preſerve the center of gravity of their bodies from falling too far to a ſide of the joint of the thigh that ſupports them when the other is raiſed, which would endanger their tumbling to the ground.

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(*a*) Albin de oſſib. § 339.

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THE

THE

ANATOMY

OF THE

HUMAN NERVES.

AND

A DESCRIPTION of the HUMAN LACTEAL SAC and DUCT.

The EIGHTH EDITION.

By ALEXANDER MONRO *Senior*, *M. D.* and *P. A.*

PREFACE

To the Seventh EDITION.

BEING informed that the following Eſſays have been uſeful to the ſtudents in anatomy, I have cauſed them to be reprinted with ſuch amendments as I thought neceſſary.

That offence might not be given I have treated all the opinions concerning the diſputed phyſiology of the nerves with that deference which the uncertainty of the ſubject required; and have not only concealed the names of the writers whoſe ſentiments were different from mine, but have ſhunned quotations from thoſe whom I approve, leſt the knowledge of the latter ſhould be a key to diſcover the former by.

Deſcriptions of very minute ramifications of the nerves are obſcure to the young gentlemen for whoſe uſe I write; and therefore I have taken notice only of the larger branches in the deſcription of the particular nerves.

The firſt occaſion of my publiſhing my great Maſter Boerhaave's doctrine concerning the Syſtole and Diaſtole of the heart, was to prevent the imputation I might have lain under of aſſuming it to myſelf, when

when my worthy Master and good friend Mr Cheselden inserted it into his anatomy, as communicated by me, without mentioning Boerhaave's name. Having now taken away all grounds of such imputation, and the doctrine, though simple and beautiful, not appearing sufficient to account for the phænomena of the motions of the heart, I have omitted it in this edition.

The description of the receptaculum chyli and thoracic duct is more accurate, than in the common systems of anatomy; and on that account is here republished.

The corrections and additions made in this edition of the anatomy of the bones, and of these Essays, show, that I pretend not to Perfection; but I would however wish, that no more faults were imputed to me than what are really my own.

THE

THE

ANATOMY

OF THE

HUMAN NERVES.

Of the NERVES in general.

1. THE numerous turns which the *carotid* and *vertebral* arteries make before they paſs through the *dura mater*, theſe arteries having neither ſwelling muſcles nor preſſure of the atmoſphere to aſſiſt the courſe of the blood in them after they enter the ſcull, and their diviſion into innumerable communicating branches in the *pia mater*, and its proceſſes, ſhew, that the liquors muſt move more ſlowly and equally in them than in moſt other parts of the body.

2. By the aſſiſtance of injections and microſcopes, the very minute branches of theſe veſſels (§ 1.) are diſcovered to go from the *pia mater*, into the *cortex*, cineritious, or aſhy-coloured part of the *cerebrum*, *cerebellum*, and *ſpinal marrow*; whereas we can only ſee longitudinal veſſels, without numerous ramifications

ramifications or reticular plexuſes, in the white medullary ſubſtance of theſe parts.

3. The continuity of the *cortex* with the *medulla* of the *encephalon* and *ſpinal marrow* is obſervable with the naked eye, and is more diſtinctly ſeen with the aſſiſtance of a microſcope.

4. In diſſecting the *brain* and *cerebellum*, we ſee the ſmall beginnings of the *medulla* proceeding from the *cortex*, and can trace its gradual increaſe by the addition of more ſuch white ſubſtance coming from the *cortex*.

5. Both theſe ſubſtances (§ 4.) are very ſucculent; for being expoſed to the air to dry, they loſe more of their weight than moſt other parts of the body do.

6. In ſeveral places we can obſerve the *medulla* to be compoſed of fibres laid at each others ſides.

7. The medullary ſubſtance is employed in forming the white fibrous cords, which have now the name of *nerves* appropriated to them. Within the ſcull we ſee the nerves to be the medullary ſubſtance continued; and the *ſpinal marrow* is all employed in forming nerves.

8. The common opinion concerning the riſe of the nerves, founded on a ſuperficial inſpection of thoſe parts, is, that the nerves are propagated from that ſide of the *encephalon*, at which they go out of the ſcull. But it having been remarked, after a more ſtrict inquiry, and preparing the parts by maceration in water, that the medullary fibres decuſſate or croſs each other in ſome parts of the *medulla*; as for example, at the *corpus annulare*, and

and beginning of the *ſpinal marrow*: And practical obſervators having related ſeveral examples of people whoſe brain was hurt on one ſide, while the morbid ſymptom, palſy, appeared on the other ſide of the body, of which I have ſeen ſome inſtances; and experiments made on brutes having confirmed theſe obſervations, it has been thought, that the nerves had their riſe from that ſide of the *encephalon*, which is oppoſite to their egreſs from the ſcull. It may however ſtill be ſaid, that this laſt opinion is not fully demonſtrated, becauſe a decuſſation in ſome parts is not a proof that it obtains univerſally; and if there are examples of palſy of the ſide oppoſite to where the leſion of the brain was, there are alſo others, where the injury done to the brain and the palſy were both on the ſame ſide.

9. The nerves are compoſed of a great many threads lying parallel to each other, or nearly ſo, at their exit from the *medulla*.

This fibrous texture is evident at the origin of moſt of the nerves within the ſcull; and in the *cauda equina* of the *ſpinal marrow*, we can divide them into ſuch ſmall threads, that a very good eye can ſcarce perceive them; but theſe threads, when looked at with a microſcope, appear each to be compoſed of a great number of ſmaller threads.

10. How ſmall one of theſe fibrils of the nerves is, we know not; but when we conſider that every, even the moſt minute part of the body is ſenſible, and that this muſt depend on the nerves (which all conjoined, would not make a cord of an inch diameter) being divided into branches or filaments to be diſperſed

ed through all these minute parts, we must be convinced that the nervous fibrils are very small. From the examination of the *minimum visibile*, it is demonstrated, that each fibre in the *retina* of the eye or expanded optic nerve, cannot exceed the size of the 32,400 part of a hair.

11. The medullary substance, of which the nervous fibrils are composed, is very tender, and would not be able to resist such forces as the nerves are exposed to within the bones, nor even the common force of the circulating fluids, were not the *pia mater*, and *tunica arachnoides* continued upon them; the former giving them firmness and strength, and the latter furnishing a cellular coat to connect the threads of the nerves, to let them lye soft and moist, and to support the vessels which go with them.

It is this cellular substance that is distended when air is forced through a blow-pipe thrust into a nerve, and that makes a nerve appear all spongy, after being distended with air till it dries; the proper nervous fibrils shrivelling so in drying, that they scarce can be observed.

13. These coats (§ 11.) would not make the nerve strong enough to bear the stretching and pressure they are exposed to in their course to the different parts of the body; and therefore, where the nerves go out at the holes in the *cranium* and *spine*, the *dura mater* is generally wrapt closely round them, to collect their disgregated fibres into tight firm cords; and that the tension which they may happen to be exposed to, may not injure them before

they have got this additional coat, it is firmly fixed to the sides of the holes in the bones through which they pass.

13. The nervous cords thus composed of nervous fibrils, cellular coat, *pia* and *dura mater*, have such numerous blood vessels, that after their arteries only are injected, the whole cord is tinged of the colour of the injected liquor; and if the injection is pushed violently, the cellular substance of the nerves is at last distended with it.

14. A nervous cord, such as has been just now described, (§ 13.) has very little elasticity, compared with several other parts of the body. When cut out of the body, it does not become observeably shorter, while the blood vessels contract three eighths of their length.

15. Nerves are generally lodged in a cellular or fatty substance, and have their course in the interstices of muscles, and other active organs, where they are guarded from pressure; but in several parts they are so placed, as if it was intended that they should there suffer the vibrating force of arteries, or the pressure of the contracting fibres of muscles.

16. The larger cords of the nerves divide into branches as they go off to the different parts; the branches being smaller than the trunk from which they come, and making generally an acute angle where they separate.

17. In several places, different nerves unite into one cord, which is commonly larger than any of the nerves which form it.

18. Several nerves, particularly those which are distributed to the bowels, after such union, (§ 17.), suddenly form a hard knot considera-

bly larger than all the nerves of which it is made. These knots were called *corpora olivaria*, and are now generally named *ganglions*.

19. The *ganglions* have thicker coats, more numerous, and larger blood-vessels than the nerves; so that they appear more red and muscular. On dissecting the *ganglions*, fibres are seen running longitudinally in their axes, and other fibres are derived from their sides in an oblique direction to the longitudinal ones.

20. Commonly numerous small nerves, which conjunctly are not equal to the size of the *ganglion*, are sent out from it, but with a structure no way different from that of other nerves.

21. The nerves sent to the organs of the senses, lose there their firm coats, and terminate in a pulpy substance. The *optic nerves* are expanded into the soft tender webs, the *retinæ*. The *auditory nerve* has scarce the consistence of *mucus* in the *vestibulum*, *cochlea*, and *semicircular canals* of each ear. The *papillæ* of the nose, tongue and skin, are very soft.

22. The nerves of muscles can likeways be traced till they seem to lose their coats by becoming very soft; from which, and what we observed of the sensatory nerves (§ 21.) there is reason to conclude, that the muscular nerves are also pulpy at their terminations, which we cannot indeed prosecute by dissection.

23. It would seem necessary that the extremities of the nerves should continue in this soft flexible state, (§ 21. 22.), in order to perform their functions right: For, in proportion as parts become rigid and firm by age, or any other cause, they lose of their sensibility, and the motions are more difficultly performed.

24. Though

24. Though the fibres in a nervous cord are firmly connected, and frequently different nerves join into one trunk, or into the same *ganglion*: yet the ſenſation of each part of the body is ſo very diſtinct, and we have ſo much the power of moving the muſcles ſeparately, that, if the nerves are principal agents in theſe two functions, which I ſhall endeavour to prove they are, we have reaſon to believe that there is no union, confuſion or immediate communication of the proper nervous fibrils, but that each fibre remains diſtinct from its origin to its termination.

25. Changes produced any way upon the coats of the nerves, cannot however miſs to affect the nervous fibrils. The cellular ſubſtance may be too full of liquor, or may not ſupply enough; the liquor may not be of a due conſiſtence, or it may be preternaturally obſtructed and collected. The *pia* or *dura mater*, may be too tenſe, or too lax; their veſſels may be obſtructed; their proper nerves may be violently irritated, or loſe their power of acting; and a great many other ſuch changes may happen, which will not only occaſion diſorders in particular nerves, but may be a cauſe of the *ſympathy* ſo frequently obſerved among the nerves; which is ſo neceſſary to be attentively regarded in a great many diſeaſes, in order to diſcover their true ſtate and nature, that, without this knowledge, very dangerous miſtakes in the practice of phyſic and ſurgery may be committed.

26. Many experiments and obſervations concur in proving, that when nerves are compreſſed, cut, or any other way deſtroyed, the

parts ſerved by ſuch nerves, farther from the head or ſpine than where the injuring cauſe has been applied, have their ſenſations, motions, and nouriſhment weakened or loſt, while no ſuch effects are ſeen in the parts nearer to the origin of thoſe nerves; and in ſuch experiments where the cauſe impeding the nerves to exert themſelves could be removed, and the ſtructure of the nerves not injured, as for example, when a ligature made upon a nerve and ſtopping its influence has been taken away, the motion and ſenſation of the parts ſoon were reſtored. From which it would appear, that the nerves are principal inſtruments in our ſenſations, motions, and nouriſhment; and that this influence of the nerves is not inherent in them, without the communication between theſe cords and their origin is preſerved.

This concluſion is juſt, notwithſtanding that ſometimes, upon cutting a nerve, the effects above mentioned have been felt for a ſhort time; but afterwards the perſon was ſenſible of no dumbneſs or immobility; for where-ever this is ſaid to have happened, the cut nerve was only one of ſeveral which were ſent to the member; the want of whoſe influence was felt no longer, than till the habit was acquired of performing the functions eaſily by the other nerves.

Nor is it of greater weight as an objection, that ſometimes when a ligature is drawn very hard upon a nerve, and then is taken away, the nerve never again recovers its influence upon the parts it is diſtributed to beyond the ligature, but is of as little effect as if it had been cut through; which is to ſay, that its texture has been altered beyond recovery. The

ſame

ſame thing is to be ſeen by tying a thread tight round a tender twig of any vegetable; it decays.

27. Experiments and obſervations ſhew too, that when parts of the *encephalon* or *ſpinal marrow* have been irritated, compreſſed, or deſtroyed, the parts of the body, whoſe nerves had their origin from ſuch affected parts of the *encephalon* or *ſpinal marrow*, became convulſed, paralytic, inſenſible, or waſted; and in ſuch caſes where the injuring cauſe could be removed from the origin of the nerves, the morbid ſymptoms obſerved in the parts to which theſe nerves were diſtributed, went off upon the removal of that cauſe. From which it is thought reaſonable to conclude, that the nerves muſt not only have a communication with their origin, but that the influence they have upon the parts they are diſtributed to depends on the influence which they derive from the *medulla encephali* and *ſpinalis*.

28. Though the *ſpinal marrow* has its own veſſels and cineritious ſubſtance which aſſiſts to form its *medulla*; yet a very large ſhare of the medullary ſubſtance within the ſpine is derived from the *encephalon*, whoſe *medulla oblongata* deſcends from the head, and the influence of the *ſpinal marrow* on its nerves depends in a great meaſure on this *medulla oblongata* of the head. Hence an injury done to any part of the *ſpinal marrow*, immediately affects all the parts whoſe nerves have their origin below where the injuring cauſe is applied. A luxation of a *vertebra* in the loins makes the lower extremities ſoon paralytic; a tranſverſe ſection of the *medulla* at the firſt *vertebra* of the neck, ſoon puts an end to life.

29. If such causes produce constantly such effects (§ 26. 27. 28.) in us and other creatures living in nearly the same circumstances as we do, the conclusions already made must be good, notwithstanding examples of children and other creatures being born without *brains* or *spinal marrow*; or notwithstanding that the brains of adult creatures can be much changed in their texture by diseases; and that *tortoises*, and some other animals, continue to move a considerable time after their heads are cut off. We may be ignorant of the particular circumstances requisite or necessary to the being or well-being of this or that particular creature, and we may be unable to account for a great many *phænomena*; but we must believe our eyes in the examination of facts; and if we see constantly such consequences from such actions, we cannot but conclude the one to be the cause and the other the effect. It would be as unjust to deny the conclusions made in the three preceeding articles, because of the seemingly preternatural phænomena, mentioned at the beginning of this, as it would be to deny the necessity of the circulation of the blood in us and most quadrupeds, because a frog can jump about, or a tortoise can walk long after all the bowels of its thorax and abdomen are taken out, or because the different parts of a worm crawl after it has been cut into a great many pieces. It is therefore almost universally allowed, that the nerves are *principal* instruments in our sensations, motion, and nourishment; and that the influence which they have is communicated from their origin, the *encephalon* and *medulla spinalis*.

But

But authors are far from agreeing about the manner in which this influence is communicated, or in what way nerves act to produce these effects.

30. Some alledge, that the *nervous fibres are all solid cords acting by elasticity or vibration*; others maintain, that *those fibres are small pipes conveying liquors, by means of which their effects are produced.*

31. The gentlemen, who think the nervous fibres solid, raise several objections to the other doctrine; which I shall consider afterwards; and endeavour to shew the fitness of their own doctrine to account for the effects commonly observed to be produced by the nerves.

The objects of the senses plainly (say they) make impulses on the nerves of the proper organs, which must shake the nervous fibrils: and this vibration must be propagated along the whole cord to its other extremity or origin; as happens in other tense strings; and these vibrations being differently modified, according to the difference of the object, and its different application, produce the different ideas we have of objects.

32. To this account of sensation, it is objected, *first*, That nerves are unfit for vibrations, because their extremities, where objects are applied to them, are quite soft and pappy (§ 21.), and therefore not susceptible of the vibrations supposed; and if there could be any little tremor made here by the impulse of objects, it could not be continued along the nervous cord, because the cellular substance by which each particular fibre is connected to the neighbouring

bouring ones (§ 11.), and the fatty ſubſtance in which the nervous cord is immerſed (§ 15.), would ſoon ſtifle any ſuch vibratory motion.

A *ſecond* objection to this doctrine is, that ſuppoſing the nerves capable of vibrations by the impreſſions of objects, theſe vibrations would not anſwer the deſign. For if what we know of other vibrating ſtrings, to wit, that their tone remains the ſame, unleſs their texture, length or tenſion is altered, and that different ſubſtances ſtriking them do no more than make the ſound higher or lower; if theſe properties are to be applied to nerves, then it will follow, that the ſame nerve would conſtantly convey the ſame idea, with no other variety than of its being weaker and ſtronger, whatever different objects were applied to it; unleſs we ſuppoſed the nerve changed in its texture, length, or tenſion, each time a different object is applied; which, it is preſumed, no body will undertake to prove does happen.

Nay, *3dly*, If ever ſuch a variety of vibrations could be made, our ſenſations would notwithſtanding be confuſed and indiſtinct, becauſe the tremulous nervous fibre being firmly connected and contiguous to ſeveral other fibres of the ſame cord would neceſſarily ſhake them too, by which we ſhould have the notion of the object as applied at all the different parts where the extremities of theſe fibres terminate.

33. In whatever way the favourers of the doctrine of ſolid nerves pleaſe to apply the elaſticity of nerves to the contraction of muſcles, their adverſaries inſiſt that nerves are too weak to reſiſt ſuch weights as the muſcles ſuſtain; they would ſurely break, eſpecially as they

they are in a great measure, if not wholely, deprived of their strong coats before they come to the part of the muscle they are immediately to act upon (§ 22.)—The nerves being found to have little or no elasticity to shorten themselves (§ 14.), shews them altogether unfit for such an office as this of contracting muscles in the way proposed of their acting by elasticity; and when a nerve is viewed with a microscope while the muscles it serves are in action, no contraction or motion is observed in it.——— Nay, if they were elastic, they would equally exert their power of contracting muscles nearer to their origin as well as farther from it, when they were put into contraction or vibration, by irritation of any part of them. The former however does not happen.

34. As a further objection against either motion or sensation being owing to the elasticity of the nerves, it is said, that if this doctrine was true, the sensations would be more acute, and the contractions of muscles would be greater and stronger, when the parts become firmer and more rigid by age; for then their elasticity is increased: Whereas, on the contrary, it appears (§ 23.) that then the sensations are blunted, and muscular contraction becomes less and weaker.

35. If the nerves were granted to be elastic, and to communicate a springy force to all the parts they are distributed to, they might appear necessary in this view to assist the application of the nutritious particles of the fluids to the sides of the vessels which these particles were to repair; and so far might well enough account for the share which nerves are thought to

to have in nutrition: But if we cannot make use of elasticity in the other two functions, sensation and motion, we must also endeavour to find out some other way for the nerves to act in nutrition, which will be done afterwards.

36. Having thus stated the reasons for and against the nerves acting as solid strings, let us likewise relate the arguments for nerves being pipes, and the objections to this doctrine.

A great argument of those who think the nerves to be tubes conveying liquors, is the strong analogy of the brain and nerves to other glands of the body and their excretories, where a manifest secretion of liquor is made in the glands, to be conveyed by the excretories to the proper places in which it ought to be deposited: They think that the vascular texture of the *cortex* of the *encephalon* and *spinal marrow* (§ 2), the continuation of the *cortex* in forming the medullary substance (§ 3. 4.), the fibrous texture (§ 6.), and succulent state of this *medulla* (§ 5.), and its being wholly employed to form the nerves (§ 7.), where the fibrous texture is evident (§ 9.); all these things, say they, conspire to shew such a strong analogy between these parts and the other glands of the body, as carries a conviction that there is a liquor secreted in the *encephalon* and *spinal marrow*, to be sent out by the nerves to the different parts of the body.

37. The following objections are raised to this argument in favour of liquor conveyed in the nerves from the analogy of the glands. 1*st*, Other glands, it is said, have their excretories collected into a few large pipes, and not continued in such a great number of separate pipes,

pipes as far as the places where the liquors are depoſited; which laſt muſt be the caſe, if the nerves are the excretories of the glandular brain. 2*dly*, We ſee the cavities, and can examine the liquors in the excretories of other glands much ſmaller than the brain; which cannot be done in the nerves. 3*dly*, If the nerves were pipes, they would be ſo ſmall, that the attraction of the liquors to their ſides, would prevent that celerity in the motion of the liquors, which is requiſite to ſenſations and motions. 4*thly*, If the nerves were pipes, they would be cylindrical ones, and conſequently not ſubject to diſeaſes; or at leaſt we could have no comprehenſion of the diſeaſes in them.

38. The anſwer to the 1*ſt* of theſe objections is, That there are other glands where there is a manifeſt ſecretion, and in which the diſpoſition of the excretories is in much the ſame way as in the *encephalon*: The kidneys, for example, have a reticulated *cortex* of veſſels, from which the *Euſtachian* or *Bellinian medulla*, conſiſting of longitudinal fibres and a few blood veſſels in the ſame direction, proceeds; and this *medulla* is collected into ten, twelve, or more *papillæ*, each of which is formed of numerous ſmall ſeparate pipes, which ſingly diſcharge the urine into the large membranous tubes; and theſe united form the *pelvis*. Upon comparing this texture of the kidneys with that of the *encephalon* (§ 2. 3. 4. 5. 6. 7. 9.) the analogy will be found very ſtrong.

39. In anſwer to the 2*d* objection, in § 37. it is granted, that microſcopes, injections, and all the other arts hitherto employed, have not ſhewn the cavities of the nervous fibrils, or

the

the liquors contained in them; and from what was ſaid (§ 10.) of the ſmallneſs of the nervous fibrils, it is not to be expected that ever they ſhould be ſeen. But ſo long as ſuch a number of little animals can every hour be brought to the objectors, in which they can as little demonſtrate the veſſels or contained fluids, it will not be allowed to be concluſive reaſoning, that becauſe ocular demonſtration cannot be given of either the tubes or their contents, therefore they do not exiſt. For if we have any notion of an animal, it is its being an hydraulic machine, which has liquors moving in it as long as it has life; if therefore ſuch little animals have veſſels and liquors which we cannot ſee, why may not ſome of the veſſels and liquors of the human body be alſo inviſible to us?

To avoid this anſwer to the objection, it is further urged, That though we might not ſee the nervous tubes or the liquors they contain as they naturally flow; yet if ſuch liquors really exiſt, they ought to diſcover themſelves, either by a nerve's ſwelling when it is firmly tied; or that, however ſubtile their fluids are, they might be collected in ſome drops, at leaſt, when the cut end of a nerve of a living animal is kept ſome time in the exhauſted receiver of an air-pump. It is affirmed, that neither did the tied nerve ſwell between the brain and ligature, nor was there any liquor collected in the receiver of the air-pump; from which it is concluded, that there is no liquor in the nerves.

Some, who ſay they have tried theſe experiments, affirm, that in young animals the nerve does ſwell above the ligature, and that

a liquor does drill out upon cutting a nerve. ——Whether ſwelling or liquor is ſeen or is not ſeen in theſe experiments, no concluſion for or againſt a nervous fluid can be made from them; for the ſwelling of the nerve after it is tied, or the efflux of liquors from its extremity, will never prove either to be the effect of the fluid in the proper nervous fibrils, ſo long as they might be occaſioned by the liquors in the larger veſſels of the cellular ſubſtance of the nerves; and if theſe ſame veſſels of the coats of the nerves do not diſcover their liquors by theſe experiments, it is far leſs to be expected, that the much more ſubtile nerves will diſcover theirs.

40. The 3*d* Objection to the doctrine of the brain being a gland, and the nerves, its excretories, ſuppoſes a more rapid motion neceſſary in the fluid of the nerves, than what moſt of the defenders of the nervous fluid will now allow; and is afterwards to be conſidered particularly in a more proper place.

41. The 4*th* objection being, That if nerves are excretories of a gland, they muſt be cylindrical pipes, in which no obſtructions or diſeaſes would happen; but ſince we daily ſee diſeaſes in the nerves, they muſt therefore not be ſuch excretories. The anſwer is, That diſeaſes happen often in the excretories of other glands, as of the liver, kidneys, *&c.* notwithſtanding their cylindrical form, and their much ſhorter and leſs expoſed courſe. When we conſider the very tender ſubſtance of the brain, the vaſt complication of veſſels there, the prodigious ſmallneſs of the pipes going out from it, the many moving powers which the nerves

are to undergo the ſhock of, and the many chances which the veſſels, membranes, and cellular ſubſtance accompanying the nerves have of being diſordered, and then affecting the nervous fibrils, we have very great reaſon to be ſurpriſed, that theſe cylindrical pipes are not much more frequently put out of order, by too great or too ſmall a quantity of liquors: by too viſcid or too thin fluids: by liquors conſiſting of too mild and ſluggiſh particles, or of too acrid pungent ones; by too great or too little motion given to the liquors; by the diameters of the pipes being too much ſtraitened, or too much inlarged; and by a great many other varieties of circumſtances which might be thought capable of diſturbing the functions of the nerves, ſuppoſing them to be cylindrical excretories of the gland, the brain.

42. The numerous veſſels of the *encephalon* have brought ſome of the gentlemen who aſſert the nerves to be ſolid, to acknowledge, that there is a liquor ſecreted in the brain: But then they will not allow that this liquor is ſent out by the proper nervous fibrils; but that it is poured into the cellular ſubſtance in which the nerves lie, to keep them moiſt and ſupple, and therefore fit for exerting their elaſticity, vibration, *&c.* by which, in their opinion, the effects commonly aſcribed to nerves are produced.

43. Beſides the objections already mentioned (§ 32. 33) againſt the nerves acting as elaſtic ſtrings, this opinion has ſome other difficulties which may be objected to it: For inſtance, there is not one analogous example in the whole body of liquors ſecreted in a large gland, to be poured into a cellular ſubſtance,

as

as is here ſuppoſed; the liquors in the cells of the *tela cellularis* of other parts are ſeparated from the little arteries which are diſtributed to theſe cells.

Further, it cannot be imagined, how a liquor ſecreted in the *cortex* of the brain ſhould make its way through the *medulla*, to come out into the cellular membranes on the ſurface of that *medulla*.

Laſtly, A very ſimple experiment, of injecting water by the artery of any member, and thereby filling the cellular ſubſtance of the nerves of that member, ſhews evidently, that the liquor of the *cellular* ſubſtance of the nerves has the ſame fountain as the liquor has in the *tela cellularis* any where elſe, that is, from the little arteries diſperſed upon it.

44. The doctrine of a fluid in the nerves, is not only thus ſupported by the analogy of the brain and nerves to the other glands and their excretories, but thoſe who maintain this doctrine mention an experiment which they think directly proves a fluid in the nerves. It is this: After opening the thorax of a living dog, catch hold of and preſs one or both the *phrenic* nerves with the fingers, the *diaphragm* immediately ceaſes to contract; ceaſe to compreſs the nerves, and the muſcle acts again: A ſecond time, lay hold of the nerve or nerves ſome way above the *diaphragm*, its motion ſtops. Keep firm the hold of the nerve, and, with the fingers of the other hand ſtrip it down from the fingers which make the compreſſion towards the *diaphragm*, and it again contracts: A repetition of this part of the experiment three or four times,

is always attended with the same effects; but it then contracts no more, strip as you will, unless you remove the pressure, to take hold of the nerves above the place first pinched; when the muscle may again be made to contract, by stripping the nerve down towards it. This experiment I have done with the success here mentioned. Let any one try if he can imagine any other reasonable account of these appearances, than that the pressure by the fingers stopped the course of a fluid in the nerve: that so much of this fluid as remained in the nerve, betwixt the fingers and *diaphragm* was forced into that muscle by stripping, and when it was all pressed away, the fingers above preventing a supply, the muscle contracted no more till the fingers were removed, and a fresh flow by that means was received from the spinal marrow, or from that part of the nerve which had yet not been so stripped.

It has been objected to the conclusions from this experiment, 1. That the *diaphragm* is set in motion by stripping the nerve from, as well as towards, this muscle; and this may be well expected; for a liquor in such small pipes hindered to flow backwards by ligature, pinching fingers, or even the flow of their liquors from the fountain, will regurgitate forewards with velocity, when pressed backwards. We see it happen in the stalks of tender succulent plants.

2. It is said, that muscles cease to act when their veins are tied, as well as when their arteries or nerves are tied or cut, but that muscles continue to act when their veins are cut; by

by which it would appear, that the overloading of the veſſels is an impediment to the action of muſcles, and therefore the ceaſing of their action when their arteries or nerves are tied or cut, may alſo be owing to the liquor in the branches of theſe pipes of muſcles ſtagnating when it is not propelled by the flow of more liquor from their trunks, and not to any influence or moving power, which now ceaſes to be conveyed to them.

It is to be obſerved in making the experiments juſt now mentioned, that the contraction of the muſcles ceaſes ſooneſt when the nerves, and lateſt when the veins are tied.——That when veins are tied, not only are the veſſels overloaded, but all the cellular ſubſtance of the muſcles is filled with coagulated blood; whereas when the arteries and nerves are tied, the reverſe is ſeen, the muſcles are lax and of leſs bulk. So that in theſe caſes the ceaſing of the contraction of the muſcles ſeems to depend on very different cauſes, to wit, a deprivation of neceſſary liquors in the one, and a redundancy of ſuperfluous blood in the other. An elaſtic ſtick may be deprived of its elaſticity by being made either too dry or too wet.

45. Some gentlemen, convinced of the reaſonableneſs of the ſecretion of a liquor in the brain to be ſent out by the nerves, but not comprehending how a fluid could have ſuch a rapid retrograde motion as they imagined was neceſſary for conveying the impreſſions of objects made on the extremities of nerves to the *ſenſorium*, ſuppoſed two ſorts of nerves; one that conveyed a liquor for muſcular motion and nutrition; the other compoſed of ſolid

nerves, that were to ſerve for organs of the ſenſes, to convey the vibrations communicated from objects to the *ſenſorium*.

46. To this opinion (§ 45.) the objections againſt the ſenſatory nerves acting by vibration (§ 32.) may be made; and there is ſo little reaſon to ſuſpect any difference in the texture of the different parts of the brain or nerves, that, on the contrary, the ſtructure is every where ſimilar, and branches of the ſame nerve often ſerve both for ſenſation and motion.

How little neceſſity there is for ſuppoſing extremely rapid motions of the nervous fluid, is to be examined ſoon.

47. The hypotheſis of great celerity in the motion of the fluid of the nerves being neceſſary, gave alſo riſe to another diviſion of the nerves, into *arterious* or *effluent*, and *venous* or *refluent*. It was ſaid, that muſcular motion and nutrition depended on the arterious nerves; and that the ſenſations depended on an accelerated motion of the nervous fluid towards the brain, by the impreſſions which the objects of the ſenſes make upon the venous nerves. By this ſuppoſition the abſurdity of rapid fluxes and refluxes in the ſame canal was prevented, and an advantage was thought to be gained by it, of ſaving too great a waſte of the fluid of the nerves, which otherwiſe the *encephalon* and *ſpinal marrow* could not ſupply in ſufficient quantity to anſwer all the exigencies of life.

48. To this opinion (§ 47.) it has been objected, 1*ſt*, That there is no example in the body of a ſecreted liquor being returned immediately

mediately and unmixed to the gland by which it was originally separated from the mass of blood; which would be the case were there venous nerves. 2*dly*, There is no occasion for saving the fluid of the nerves in the way proposed; the organs for secreting that fluid being large enough to supply all that is necessary of it in the common functions of life.—— 3*dly*, If the fluid of the nerves was to be thus kept in a perpetual circulation, it would soon become too acrid for continuing with safety in such sensible tender vessels as the brain and nerves are composed of. 4*thly*, This hypothesis will not answer the design for which it was proposed: For though the momentary application of an object might cause an acceleration in the fluid of venous nerves, yet if the object was kept applied to the nerves, it would stop their fluid, so that it could not go foreward to the brain; and therefore, according to this doctrine, we should be sensible of no objects, except those whose application to the organs of the senses was momentary.

49. Let us now suppose it probable, that the *encephalon* and *spinal marrow* secern a liquor from the blood which is sent into all the nerves, and that by the means of this liquor, the nerves perform the offices commonly assigned to them; it is next necessary to enquire what kind of liquor this is, and how it moves, in order to determine how well its nature and motion are fitted for performing what is expected from it.

50. The liquor of the nerves has been fancied by some to be of a very strong acid or alcaline

alcaline nature: But since none of our juices appear to be of this sort, and since such liquors irritate and destroy the parts of the body which they are applied to, we cannot conceive how the brain can separate, or the nerves could bear any thing of such an acrid nature. This tenderness and sensibility of these organs must hinder us absolutely from supposing that the liquor of the nerves can be acrid or pungent, or of the nature of spirit of wine, hartshorn, &c.

51. Some have imagined the liquor of the nerves to be capable of vast explosion like gun powder, or of violent sudden rarefaction like air, or of strong ebulition like boiling water, or the mixture of acids with alcaline liquors. But as the mass of blood from which this fluid is derived, is not possessed of any such properties, we cannot suppose the blood to furnish what it has not in itself. Besides, all these operations are too violent for the brain or nerves to bear; and when once they are begun, they are not so quickly controlled or restrained, as experience teaches us the nerves can be made to cease from acting.

52. We are not sufficiently acquainted with the properties of an *æther* or *electrical effluvia* pervading every thing, to apply them justly in the animal œconomy; and it is as difficult to conceive how they should be retained or conducted in a long nervous cord. These are difficulties not to be surmounted.

53. The surest way of judging what kind of liquor this of the nerves must be, is to examine the liquors of similar parts of the body. All the glands separate liquors from the blood much thinner than the compound mass

maſs itſelf; ſuch is the *liquor* poured into the cavity of the *abdomen*, *thorax*, *ventricles of the brain*, the *ſaliva*, *pancreatic juice*, *lymph*, &c. Where-ever there is occaſion for ſecreted liquors being thick and viſcid, in order to anſwer better the uſes they are intended for, nature has provided reſervoirs for them to ſtagnate in, where their thinner parts may be carried off by the numerous abſorbent veins diſperſed on the ſides of thoſe cavities; or they may exhale where they are expoſed to the open air. The *mucus of the noſe* becomes viſcid by ſtagnation; for, when it is immediately ſecreted, it is thin and watery; as appears from the application of ſternutatories, &c. The *cerumen* of the ears is of a watery conſiſtence, when juſt ſqueezing out. The *mucus* of the alimentary canal grows thick in the *lacunæ*. The *bile* in the hepatic duct has little more conſiſtence than lymph; that in the gall-bladder is viſcid and ſtrong. The *urine* is much more watery as it flows from the kidneys, than when it is excreted from the bladder. The *ſeed* is thin as it comes from the teſticles, and is concocted in the *veſiculæ ſeminales*, &c.

54. Hence (§ 53.) we may ſafely conclude, that a thin liquor is ſecreted in the *cortex encephali* and *ſpinal marrow*; and ſeeing the thinneſs of ſecreted liquors is generally, as the diviſions of the veſſels, into ſmall ſubtile branches, and that the ramifications within the ſcull are almoſt infinitely ſubtile, the liquor ſecreted in the *encephalon* may be determined to be among the fineſt or thinneſt fluids.

55. Seeing alſo that we can obſerve no large reſervoir,

reſervoir, where the liquor ſecerned in the *cortical ſubſtance* is depoſited, to have its finer parts taken off, we have reaſon to think, that it goes foreward into the nerves in the ſame condition in which it is ſecerned.

56. By fine or ſubtile animal liquors, is meant no more than thoſe which are very fluid, and which ſeem to conſiſt of a large proportion of watery particles, and a leſſer one of the oily, ſaline, and terreſtrious particles. Some of the liquors which we can have in ſufficient quantity to make experiments with, are ſo fluid, and have ſo little viſcidity or coheſion of parts that when laid upon a piece of clean mirror, they evaporate without leaving a ſtain; ſuch is the liquor ouſing out from the ſurface of the *pleura*, the lymph, and ſeveral others.

If then theſe liquors, which are ſubject to our examination, the ſecerning veſſels of which are ſo large that we can ſee them, have ſuch a ſmall coheſion of parts, it might not be unreaſonable to ſay, that the liquor of the nerves is as much more fine and fluid than lymph as the veſſels ſeparating it are ſmaller; and therefore that the fluid of the nerves is a defecated water, with a very ſmall proportion of the other principles extremely ſubtilized.

57. Two experiments are ſaid to contradict this opinion of the liquor of the nerves being ſo fluid and ſubtile. One is, that upon cutting the *cauda equina* of a living animal, a liquor as viſcid as the white of an egg drops out: The other is, that a wounded nerve yields a *glairy ſanies*. But theſe don't appear to be the proper fluid of the nerves; ſince it is evident, that what is diſcharged in both theſe caſes, comes out of the cellular

cellular ſubſtance involving the nervous fibrils.

58. Conſidering how many experiments make it evident, that there is a conſtant, uninterrupted ſtream of liquors flowing through all the canals of animals, which convey liquors compoſed of particles ſmaller than the diameter of their canal, which is always the caſe of the nerves in a natural ſtate; it is ſurpriſing how it ever could be thought that the liquid of the nerves ſhould be obliged to flow from the brain to each muſcle the moment we will; or that this liquor ſhould flow back with the like ſwiftneſs from the extremity of each nerve, to which an object of ſenſation is applied. The nerves, as well as the other excretories of the glands, always are full of liquor; the degree of diſtenſion of the canals not being at all times alike even in a ſound ſtate. But this happens without inconvenience, as the ſides of the canals have a power to accommodate themſelves to the preſent quantity, unleſs it is very much above or below the natural ſtandard; in both which caſes diſeaſes enſue.

59. The motion of the fluid in the nerves is therefore not only conſtant, but it is alſo equal, or nearly ſo: For, though the blood in the larger arteries is moved unequally by the unequal forces, the contraction of the ventricle of the heart, and the weaker power, the *ſyſtole* of the arteries; yet the difference between theſe two moving powers comes to be leſs and leſs perceptible, as the arteries divide into ſmaller branches; becauſe of the numerous reſiſtances which the liquors meet with, and becauſe the canals they move in become lar-

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ger, till in the very ſmall arterious branches, there is no ſenſible difference in the velocity of the liquors from the effect of the heart or arteries. The motion of the fluids muſt ſtill be more equal in the excretories of glands, and particularly in thoſe where the veſſels have divided into very minute branches, and the liquors have no other propelling force but the heart and arteries, (ſee § 1); therefore the nervous fluid moves conſtantly, equally, and ſlowly, unleſs when its courſe is altered by the influence of the mind, or by the preſſure of ſome neighbouring active organ.

60. As there is neither proof nor probability of the *valves* ſuppoſed by ſome in nerves, we are not to aſſume them in accounting for any *phænomena*.

61. We have not, and perhaps cannot have any idea of the manner in which mind and body act upon each other; but if we allow that the one is affected by the other, which none deny, and that the fluid of the nerves (whatever name people pleaſe to give it) is a principal inſtrument which the mind makes uſe of to influence the actions of the body, or to inform itſelf of the impreſſions made on the body, we muſt allow that the mind can direct this inſtrument differently, particularly as to quantity and celerity, though we muſt remain ignorant of the manner how many *phænomena* depending on this connection of mind and body are produced. Thus we would in vain attempt to account for animals continuing, after their heads were ſtruck off or their hearts were cut out, to perform actions begun before they ſuffered any injury.

62. Let

62. Let us now ſuppoſe the nervous fluid ſuch as has been argued for, to wit, a very-fluid ſaponaceous water, moving in a conſtant, equal, ſlow ſtream, from the *encephalon* and *ſpinal marrow*, in each of the proper nervous fibres, except when the motion is changed by ſome acceſſory cauſe, ſuch as the mind, preſſure of other parts, &c.; and let us examine how well ſuch a ſuppoſition will agree with the *phænomena* of the three great functions, nutrition, ſenſation, and muſcular motion, which the nerves are principal inſtruments of.

63. In general, we may ſay, that nerves can carry fluids to the moſt minute part of the body, to ſupply what is waſted in any of the ſolids; that the impreſſion made by the objects of the ſenſes on the very ſoft pulpy extremities of the nerves of the organs of the ſenſes, muſt make ſuch a ſtop in the equal-flowing nervous fluid, as muſt inſtantaneouſly be perceptible at the fountain-head from which the pipes affected ariſe; that the conſtant flow of the liquor of the nerves into the cavities of the *muſcular fibrillæ*, occaſions the natural contraction of the muſcles, by the as conſtant *niſus* it makes to increaſe the tranſverſe and to ſhorten the longitudinal diameter of each fibre; and that it is only to allow the mind a power of determining a greater quantity of this ſame fluid with a greater velocity into what muſcular fibres it pleaſes, to account for the voluntary ſtrong action of the muſcles.

64. But ſince ſuch a ſuperficial account would not be ſatisfactory, it will be expected, that the principal *phenomena* of theſe three functions ſhould be explained by the means of

such a fluid as has been supposed; and that the several objections against this doctrine should be answered; Let as attempt this; and where we cannot extricate ourselves from difficulties which may be thrown in, let us honestly acknowledge ignorance.

65. *α.* If water, with a very small proportion of oils and salts from the earth, proves a fit nourishment for vegetables, such a liquor as the fluid of the nerves has been described (§ 56.) may not be unfit for repairing the waste in animals.

β. The slow continual motion of this nervous fluid (§ 58. 59.) to the most minute parts of the body (§ 10.), is well enough calculated to supply the particles that are constantly worn off from the solids by the circulation of the liquors and necessary actions of life.

γ. The greater proportional size of the *encephalon* in young creatures than in adults, seems calculated for their greater proportional growth: For the younger the animal is, the larger *encephalon* and speedier growth it has.

δ. A palsy and atrophy of the members generally accompanying each other, shew, that nourishment, sensation, and motion, depend on the same cause.

ε. It was said (§ 26.), that the nerves were *principal* instruments in nutrition: It was not affirmed, that they were the *sole* instruments; and therefore an *atrophy* may proceed from the compression or other lesion of an artery, without being an objection to the doctrine here laid down.

66. *a.* All objects of sense, when applied to their

their proper organs, act by impulse; and this action is capable of being increased by increasing the impelling force. In tangible objects, that is clearly evident; the closer they are pressed to a certain degree, the more distinct perception ensues. Odorous particles need the assistance of air moved rapidly, to affect our nose: Sapid substances, that are scarce sufficient to give us an idea of their taste by their own weight, are assisted by the pressure of the tongue upon the palate: The rays of light collected drive light bodies before them: Sound communicates a vibration to all bodies in harmonic proportion with it.

The impulses made thus by any of these objects on the soft pulpy nerves (§ 21.), which are full of liquor, presses their sides or extremities, and their liquor is hindered to flow so freely as it did The canals being all full (§ 58.) this resistance must instantaneously affect the whole column of fluids in the canals that are pressed, and their origins, and have the same effect as if the impulse had been made upon the origin itself. To illustrate this by a gross comparison: Let any one push water out of a syringe, through a long flexible pipe fixed to the syringe, and he is sensible of resistance or a push backwards, the moment any one stops the orifice of the pipe, or closes the sides of it with his fingers. This impulse made on the nerves, and thus communicated to their origin, varies according to the strength or weakness, the quickness or slowness, the continuance or speedy removal, the uniformity or irregularity, the constancy or alternation, *&c.* with which objects are applied to the nerves.

b. Whenever any object is regularly applied with due force to a nerve, rightly disposed to be impressed by it, and is communicated, as just now explained, to the *sensorium*, it gives a true and just idea of the object to the mind.

c. The various kinds of impulses which the different classes of objects make, occasion in animals, which ought to have accurate perceptions of each object, a necessity of having the different organs of the senses variously modified, so that the several impulses may be regularly applied to the nerves in each organ; or, in other words, we must have different organs of the senses fitted to the different classes of objects.

d. As the objects have one common property of impulse, so all the organs have most of the properties of the organ of touching in common with the *papillae* of the skin. In the nose and tongue, this is evident: In some operations of the eyes we can also perceive this; as we may likewise do in some cases where matter is collected in the internal ear.

e. These properties common to the different objects and organs occasion frequently uncommon effects in the application of an object to an organ proper to another object of sensation; for sometimes we have the same idea as if the object had been applied to its own proper organ: At other times the object is as it were changed, and we have the idea as if the organ had had its own proper object applied to it. Thus, for example, light is the proper object to be applied to the eye, to give us any idea of colours; yet when all light is excluded from the eyes, an idea of light and colours may be excited in us by

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couching, sneezing, rubbing, or striking the eye-ball.———A cane vibrating, so as not to excite sound perceptible to the ear, applied to the teeth, raises a strong idea of sound; as a little insect creeping in the *meatus auditorius* also does.—The fingers applied to two rough surfaces, rubbing on each other, are sensible of the sound they make; surgeons of any practice in the cure of fractured bones can bear witness to the truth of this.—The fingers dipped in acid and several other acrid liquors, have a sensation very like to tasting.—Smelling and tasting every body knows are subservient and assisting to each other. From such examples we have further proof of one general cause of our sensations, to wit, impulse from the objects; and of such a similarity and relation in the organs as might give reason for imagining that any one of them would be capible of producing the effect of another, if the impulses of the different objects could be regularly applied to each.—Hence light and sound may affect insects and other animals that have not eyes or ears.

f. If the impulse of an object is applied with due force, but irregularly, a confused idea of the object is raised. Distant object are confused to *myopes*, as very near ones are to *presbytæ*.

g. If the application of the impulse is regular, but the force with which it is applied is too weak, our perception of the object is too faint. One may whisper so low as not to be heard.

h. If the application of objects is too violent, and there is any danger of the tender organs of our senses being hurt or destroyed, an uneasy sensation we call *pain* is raised, whatever the organ thus injured is. The object of feeling

affects every organ: Thus preſſure, ſtretching, cutting, pricking, acrid ſalts, pungent oils, great heat, violent cold, *&c.* occaſion pain, where-ever they are applied. Beſides, every particular organ can be affected with pain by the too violent application of its own proper object. Too much light pains the eyes; very loud ſound ſtuns the ears; very odorous bodies and too ſapid objects hurt the noſe and tongue. A pretty ſure proof this, that the objects of our ſenſes all act, and that the organs are all impreſſed, in nearly the ſame way.

i. Since a middle impulſe, neither too ſmall nor too great, is neceſſary for a clear perception of objects, we would often be in danger of not diſtinguiſhing them, if we were not ſubjected to another law, to wit, that numerous impulſes made at once, or in a quick ſucceſſion to each other, increaſe our perceptions of objects. Thus, ſuch ſound as would not be heard on a mountain top, will be diſtinctly heard in a wainſcotted-chamber.—We feel much more clearly a tangible object when our finger is drawn alongſt it than when applied with the ſame force, but by a ſingle preſſure, upon it.—We make repeated applications of odorous and ſapid objects, when we wiſh to ſmell or taſte accurately.—The end of a burning ſtick appears much more luminous when quickly whirled in a circle than when at reſt.

k. Whenever the uneaſy ſenſation, *pain*, is raiſed by the too ſtrong application of objects, a ſort of neceſſity is as it were impoſed upon the mind to endeavour to get free of the injuring cauſe, by either withdrawing the grieved part of the body from it, as one retires his hand

hand when his finger is pricked or burnt; or the injuring cause is endeavoured to be forced from the body, as a *tenesmus* excites the contraction which pushes acrid *fœces* out of the *rectum*. In both these operations, a convulsive contraction is immediately made in the lesed part, or in the neighbourhood of it; and if the irritation is very strong or permanent, the greater part of the nervous system becomes affected in that spasmodic or convulsive way.—Is it this necessity which obliges the mind to exert herself in respiration, or in the action of the heart, when the lungs or heart are gorged with blood? or the *iris* to contract the pupil, when the eye is exposed to strong light? or sneezing to be performed when the nose is tickled? *&c.*—Will not a *stimulus* of any nerve more readily affect those with which it is any where connected than the other nerves of the body?—May not this sympathy serve as a monitor of the mind rather to employ the organs furnished with nerves thus connected, to assist in freeing her of any uneasy sensation, than to make use of any other organs?—Will not this in some measure account for many salutary operations performed in the body before experience has taught us the functions of the organs performing them?

This *nisus* of the mind to free the body of what is in danger of being hurtful, may serve to explain the *phænomena* of a great many diseases, when we are acquainted with the distribution of the particular nerves; and from this we can understand the operation of medicines that stimulate; and may learn how, by exciting a sharp, but momentary pain, we may free the body

body of another pain that would be more durable; and that, by having it thus in our power to determine a flow of the liquor of the nerves to any particular part, for the benefit of that part, or the relief of any other diseased part, we can do considerable service by a right application of the proper medicines.

l If a pain-giving cause is very violent or long continued, it destroys the organs either irrecoverably, or puts them so much out of order that they only gradually recover: People have been made blind or deaf for all their lives after a violent effect of light on their eyes, or of sound on their ears; and we are frequently exposed to as much light and sound as to make us unfit to see or hear for a considerable time. I would explain this by a ligature put round the tender branch of an herb. This ligature drawn to a certain degree, may weaken the canals so as to be unfit for the circulation of the juices a good while, till they are gradually explicated and made firm by these juices: A thicker ligature would disorder the structure of the fibres so much, that the liquors could not recover them. The analogy is so plain, that it needs no commentary ——— Thus the influence of a nerve tied with an artery in the operation of an aneurism may cease for some time, but be afterwards recovered.

67. 1. In applying the fluid of the nerves to the action of muscles, it was said, that the natural or involuntary contraction of muscles was the *nisus* which the nervous fluid flowing constantly into the muscular fibres makes to distend these fibrils, by enlarging their

their tranſverſe diameters and ſhortening their axes; and that voluntary contraction was owing to a greater quantity of that nervous liquor determined towards the muſcle to be put in action, and poured with greater *momentum* into the muſcular fibrils, by the power of the mind willing to make ſuch a muſcle to act, or obliged to do it by an irritating pain-giving cauſe (§ 66. *k*.)

2. Some object to this account of muſcular motion, that if there is no outlet for the liquor ſuppoſed to be poured into muſcular fibres, muſcles would always be in a ſtate of contraction, which they are not; and if there is a paſſage from the fibrils, the liquor would flow out as faſt as it was thrown in; and therefore no diſtenſion of the fibres or contraction of the muſcles could be made.

3. In anſwer to this objection, it is obſerved, that notwithſtanding the evident outlet from the arteries into the veins, yet the arteries are diſtended by the *ſyſtole* of the heart, or any other cauſe increaſing the *momentum* of the blood.

4. It has been alſo objected to § 1. that, if it was true, the volume of the muſcle in contraction neceſſarily would be conſiderably increaſed by ſo much liquor poured into its fibrils; whereas it does not appear, by any experiment, that the volume of a muſcle is increaſed by its being put into action.

5. To this it has been anſwered, 1. That when the axes of muſcular fibres are ſhortened, and their tranſverſe diameters are enlarged, the capacities of their fibres, and conſequently their volume, may not be changed, the diminution

diminution one way balancing the increaſe in the other. 2 That the ſpaces between the muſcular fibres are ſufficient to lodge theſe fibres when they ſwell, during the contraction of a muſcle, without any addition to its bulk; and that it plainly appears that theſe ſpaces between the fibrils are thus occupied, by the compreſſion which the larger veſſels of muſcles, which run in theſe ſpaces, ſuffer during the action of the muſcle; it is ſo great as to drive the blood in the veins with a remarkable accelerated velocity.

6. Another objection to the action of muſcles being owing to the influx of a fluid into their fibrils is, That muſcular fibres are diſtractile, or capable of being ſtretched; and therefore, when a fluid is poured into their hollow fibrils, they would be ſtretched longitudinally, as well as have their tranſverſe diameters increaſed; that is, a muſcle would become longer, as well as thicker, when it is put into action; whereas it is certainly known that a muſcle is ſhortened while it acts.

7. In anſwer to this, it has been remarked, That though muſcular fibrils are diſtractile, yet they will not yield to, or be ſtretched by every force, however ſmall, that might be applied to them. A cord that can be ſtretched in length by the weight of a pound or two, would not yield in the leaſt to an ounce or two; and it muſt likeways be obſerved, that gradually as any body is ſtretched, its reſiſtance to the ſtretching force increaſes. A rope may be ſtretched to a certain length by a pound weight appended to it, which would require two pounds to ſtretch it very little further;

ther; and therefore the general obſervation of animal fibres being diſtractile, cannot be a reaſonable objection to the account of muſcular motion above mentioned, unleſs a proof is brought that the force which the liquid of the nerves muſt exert upon each fibre of a muſcle, in order to make it act, is capable of diſtracting or ſtretching the fibres; which has not yet been attempted to be proved.—It would appear from the pain cauſed by too great an effort of muſcles, eſpecially in weak people, that muſcular fibres can bear very little diſtraction without danger of a ſolution of continuity.

8. Muſcles ceaſing to act when their arteries are tied or cut, and being brought into motion by injecting liquors into the arteries even of a dead animal, has been mentioned as objections to the nervous influence cauſing their contractions.

To the firſt of theſe experiments it may be anſwered, That the tying or cutting of the nerves ſooner produces the effect of making the contraction ceaſe than ſtopping the influx of the arterious blood does; and it will be univerſally allowed, that the influx of blood into muſcles is neceſſary for performing their functions right.

Whoever obſerves the motion which injecting water or any other liquor into the arteries of a dead animal, cauſes in its muſcles, will not compare it to what contraction, whether voluntary or excited by irritation, he may ſee in a living one.

9. If muſcular motion depends on the influx of the nervous liquid, the inſtantaneous contraction of a muſcle, when the mind wills

to

to make it act, will be eaſily underſtood from the nerves being always full of their liquor (§ 58. 66. *a.*)

10. If either the nerves of any muſcle do not furniſh a ſufficient quantity of their liquor, or if the fibres of a muſcle become too eaſily diſtractile, ſuch a muſcle will be unactive or paralytic.

11. If too great a quantity of the liquor of the nerves is determined to a muſcle or muſcles, by any cauſe which the mind cannot command, ſuch muſcle or muſcles will be convulſed.

12. If the motion of the liquid of the nerves is not uniform, but by diſeaſe becomes irregular, an alternate relaxation and contraction of muſcles may be the conſequence. Hence trembling palſies, *chorea Sancti Viti*, &c. Hence alſo the convulſive tremors which animals have when they loſe much blood.

13. Though the nerves may not furniſh ſo much liquor as may be ſufficient to make muſcles contract with ſtrength enough to overcome the reſiſtances to their actions, yet there may be a ſufficient quantity of liquor in the nerves to allow the impreſſions of objects to be conveyed to the *ſenſorium*. This may be one cauſe of a member's being ſometimes ſenſible after it cannot be moved.

14. Unleſs the liquor of the nerves acquires ſome energy in the brain, which we have no reaſon to think the circulation of the fluids in the veſſels can give it, or unleſs it has other properties than what we can diſcover in it, or unleſs there is an agent regulating its *momentum* and courſe to different parts which we

are

are not conscious of; if some of these, I say, do not obtain the action of the heart continuing of equal force to propel our liquors, notwithstanding all the resistances that are to it, is not to be explained.

15. All muscles, but especially the heart, continue to contract in an irregular way, after they are cut away from the animal to whom they belonged; which may be owing to the liquors continuing to flow in the small vessels, and being powered irregularly into the muscular *fibrillæ*,

16. It is said that a muscle cut out of the body continues some time to be capable of contraction; whereas by tying its arteries or nerves, while it is otherwise entire in the body, it loses its contracting power, which therefore does not depend on these organs, the arteries or nerves.

The loss of the power of acting when the arteries or nerves are tied while the muscle is in the body, is denied by some who made the trial, and it might be expected that the motion of a muscle would be more conspicuous where there is no resistance to it, as is the case when it is cut away from all the parts it is connected with, than when its connection remains with parts resisting its contractile efforts.

17. After the heart, or any other muscle cut away from an animal, has ceased to contract, its contraction may again be restored, by breathing upon it, or pricking it with any sharp instrument. That heat or pricking should, by their *stimulus* (§ 66. *k*.), occasion contraction in a living creature, may be understood; but how they should have the same ef-

fect in a muſcle ſeparated from an animal, I know not.

68. Some have thought the *ganglions* of nerves (§ 18. 19. 20.) to be glandular, and to perform a ſecretion.—Others, from their firm texture, ſuppoſe them to be muſcular, and to ſerve to accelerate the motion of the liquor in the nerves which proceed from them; but as no proof is offered of either of theſe opinions, they cannot be maintained.———Others would make them ſerve, 1. To divide a ſmall nerve into many nerves, and by theſe means to increaſe the number of nervous branches. 2. To make nerves come conveniently by different directions to the parts to which they belong. 3. To re-unite ſeveral ſmall nervous fibres into one large nerve.——Since no proof is brought that theſe three things cannot be done without the interpoſition of a *ganglion*, but on the contrary, we ſee them performed where there are no *ganglions*, we muſt continue to acknowledge ignorance concerning the uſes of theſe knotes, the *ganglions*.

Of the PARTICULAR NERVES.

'TIS generally ſaid, that there are forty pair of nerves in all; of which ten come out from the *encephalon*, and the other thirty have their origin from the *ſpinal marrow*.

Of the ten pair of nerves which come from the *encephalon*, the firſt is the *OLFACTORY*, which long had the name of the *mammillary proceſſes* of the brain, becauſe in the brutes,

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cows and ſheep, which were moſt commonly diſſected by the antients, the anterior ventricles of the brain are extended forewards upon theſe nerves, and adhere ſo firmly to them, that they ſeem to make the upper ſide of the nerves. Each of them being large, where it begins to be ſtretched out, and gradually becoming ſmaller as it approaches the cribriform bone, was imagined to reſemble a nipple. Thoſe who miſtook the ventricles for part of the nerves, obſerving the cavity in them full of liquor, concluded, that theſe olfactory nerves ſerved to convey the ſuperfluous moiſture of the brain to the holes of the ethmoid bone through which it paſſed into the noſe. But in man, the ventricles of whoſe brain are not thus extended forewards, theſe nerves are ſmall, long, and without any cavity, having their origin from the *corpora ſtriata*, near the part where the internal carotid arteries are about to ſend off their branches to the different parts of the brain; and in their courſe under the anterior lobes of the brain, which have each a depreſſion made for lodging them, the human olfactory nerves become larger, till they are extended to the cribriform bone; where they ſplit into a great number of ſmall filaments, to paſs through the little holes in that bone; and being joined by a branch of the fifth pair of nerves, are ſpread on the membrane of the noſe.

The tender ſtructure and ſudden expanſion of theſe nerves on ſuch a large ſurface, render it impoſſible to trace them far; which has made ſome authors deny them to be nerves: But when we break the circumference of the *cribri-*

form lamella, and then gently raise it, we may see the distribution of the nerves some way on the membrane of the nose.

The contrivance of defending these long soft nerves from being too much pressed by the anterior lobes of the brain under which they lie, is singular; because they have not only the prominent orbitar processes of the frontal bone to support the brain on each side, with the veins going into the longitudinal *sinus*, and other attachments bearing it up, but there is a groove formed in each lobe of the brain itself for them to lodge in ——— Their splitting into so many small branches before they enter the bones of the scull, is likewise peculiar to them; for generally the nerves come from the brain in disgregated filaments, and unite into cords, as they are going out at the holes of the bones. This contrivance is the best for answering the purpose they are designed for, of being the organ of smelling; for had they been expanded upon the membrane of the nose into a medullary web, such as the optic nerve forms, it would have been too sensible to bear the impressions of such objects as are applied to the nose; and a distribution in the more common way, of a cord sending off branches, would not have been equal enough for such an organ of sensation.

The 2*d* pair of nerves, the *OPTIC*, rising from the *thalami nervorum opticorum*, make a large curve outwards, and then run obliquely inwards and forewards, till they unite at the fore-part of the *sella turcica*; then soon divide, and each runs obliquely forewards and outwards to go out at its proper hole in the sphenoid bone,

bone, accompanied with the ocular artery, to be extended to the globe of the eye, within which each is expanded into a very fine cup-like web, that lines all the inside of the eye as far forewards as the *ciliary circle*, and is universally known by the name of *retina*.

Though the substance of this pair of nerves seems to be blended at the place where they are joined; yet observations of people whose optic nerves were not joined, and of others who were blind of one eye from a fault in the optic nerve, or in those who had one of their eyes taken out, make it appear, that there is no such intimate union of substance; the optic nerve of the affected side only being wasted, while the other was large and plump. And the same observations are contradictory to the doctrine of a decussation of all the nerves (§ 8.); for the disease could be traced from the affected eye to the origin of the nerve on the same side. In many fishes indeed, the doctrine of decussation is favoured; for their optic nerves plainly cross each other, without any union at the part where they are joined in men and most quadrupeds.

These people whose optic nerves were not joined, having neither seen objects double, nor turned their eyes different ways, is also a plain proof, that the conjunction of the optic nerves will not serve to account for either the uniform motions of our eyes, or our seeing objects single with two eyes, though it may be one cause of the remarkable sympathy of the one eye with the other in many diseases.

The *retina* of a recent eye, without any preparation, appears a very fine web, with some

blood veſſels coming from its center to be diſtributed on it; but after a good injection of the arteries that run in the ſubſtance of this nerve, as is common to other nerves, it is with difficulty that we can obſerve its nervous medullary ſubſtance.—The ſituation of theſe veſſels in the central part of the optic nerve; the want of medullary fibres here, and the firmneſs of this nerve before it is expanded at its entry into the ball of the eye, may be the reaſon why we do not ſee ſuch bodies, or parts of bodies, whoſe picture falls on this central part of the *retina*. An inflammation in thoſe arteries of the *retina*, which ſeveral fevers and an *ophthalmia* are generally attended with, may very well account for the tenderneſs in the eyes, and inability to bear the light, which people have in theſe diſeaſes.—The over-diſtenſion of theſe veſſels may likewiſe ſerve to account for the black ſpots obſerved on bright coloured bodies eſpecially, and for that ſmoaky fog through which all objects are ſeen by people in ſome fevers.—If theſe veſſels loſe their tone, and remain preternaturally diſtended, no objects affect our *retina*, though the eye externally appears ſound; or this may be one cauſe of an *amauroſis* or *gutta ſerena*.—From a partial diſtenſion of theſe veſſels, or *paralyſis* of a part of the *retina*, the central part, or the circumference, or any other part of objects, may be loſt to one or both eyes.

The *THIRD PAIR* riſe from the anterior part of the *proceſſus annularis*, and piercing the *dura mater* a little before, and to a ſide of the ends of the poſterior clinoid proceſs of the ſphenoid bone, run along the *receptacula*, or *cavernous ſinuſes*, at the ſide of the *ephippium*,

pium, to get out at the *foramina lacera*; after which each of them divides into branches, of which one, after forming a little *ganglion*, is diſtributed to the globe of the eye; the others are ſent to the *muſculus rectus* of the *palpebra*, and to the *attollens*, *adductor*, *deprimens*, and *obliquus minor* muſcles of the eye-ball. Theſe muſcles being principal inſtruments in the motions of the eye-lid and eye-ball, this nerve has therefore got the name of the *motor oculi*.—I have frequently obſerved in convulſions the eye-lids widely opened, the *cornea* turned upward and outwards, and the eye-balls ſunk in the orbit; which well deſcribed the conjunct action of the muſcles which this pair of nerves ſerves.—The diſtenſion of a conſiderable branch of the carotid, which paſſes over this nerve near its origin on each ſide, may poſſibly be the reaſon of the heavineſs in the eye-lids and eyes, after drinking hard, or eating much.

The *FOURTH PAIR*, which are the ſmalleſt nerves of any, derive their origin from the back-part of the baſe of the *teſtes*; and then making a long courſe on the ſide of the annular protuberance, enter the *dura mater*, a little farther back, and more externally than the third pair, to run alſo along the *receptacula*, to paſs out at the *foramina lacera*, and to be entirely ſpent on the *muſculi trochleares*, or ſuperior oblique muſcles of the eyes. Theſe muſcles being employed in performing the rotatory motions, and the advancement of the eye-balls foreward, by which ſeveral of our paſſions are expreſſed, the nerves that ſerve them have got the name of *PATHETICI*.——Why theſe ſmall nerves ſhould

ſhould be brought ſo far to this muſcle, when it could have been ſupplied eaſily by the *motor oculi*, I know not.

The *FIFTH PAIR* are large nerves, riſing from the annular proceſſes where the medullary proceſſes of the *cerebellum* join in the formation of that *tuber*, to enter the *dura mater* near the point of the petrous proceſs of the temporal bones; and then ſinking cloſe by the *receptacula* at the ſides of the *ſella turcica*, each becomes in appearance thicker, and goes out of the ſcull in three great branches.

The firſt branch of the fifth is the *OPHTHALMIC*, which runs through the *foramen lacerum* to the orbit, having in its paſſage thither a connection with the ſixth pair. It is afterwards diſtributed to the ball of the eye with the third; to the noſe, along with the olfactory, which the branch of the fifth that paſſes through the *foramen orbitarium internum* joins, as was already mentioned in the deſcription of the firſt pair. This ophthalmic branch likewiſe ſupplies the parts at the internal *canthus* of the orbit, the *glandula lacrymalis*, fat, membranes, muſcles, and teguments of the eye-lids; its longeſt fartheſt extended branch paſſing through the *foramen ſupercilliare* of the *os frontis*, to be diſtributed to the fore-head.

The ſmall fibres which this firſt branch of the fifth and the third pair of nerves ſend to the eye ball, being ſituated on the optic nerve, and, after piercing the ſclerotic coat, running along the choroid coat on the outſide of the *retina* in their courſe to the *uvea* or *iris*, may be a cauſe of the ſympathy between the optic

optic nerve and the *uvea*; by which we more readily acquire the habit of contracting the *iris*, and thereby leſſen the pupil, when too ſtrong light is excluded; and, on the contrary, enlarge the pupil, when the light is too faint.——This, with the ſympathy which muſt ariſe from ſome of the nerves of the membrane of the noſtrils, being derived from this firſt branch of the fifth pair of nerves, may alſo be the cauſe, why an irritation of the *retina*, by too ſtrong light, may produce ſneezing, as if a *ſtimulus* had been applied to the membrance of the noſe itſelf;———why preſſing the internal *canthus* of the orbit, ſometimes ſtops ſneezing;——Why irritation of the noſe or of the eye cauſes the eye-lids to ſhut convulſively, and makes the tears to flow plentifully; and why medicines put into the noſe, do often great ſervice in diſeaſes of the eyes.—In the megrim all the branches of the nerve diſcover themſelves to be affected: For the forehead is racked with pain, the eye-ball is pained, and feels as if it was ſqueezed, the eye-lids ſhut convulſively, the tears trickle down, and an uneaſy heat is felt in the noſe. Hence we can underſtand where external medicines will have the beſt effect, when applied to remove this diſeaſe, to wit, to the membrane of the noſe, and to the forehead;——why alternate preſſure near the ſuperciliary hole of the frontal bone, or ſneezing, ſometimes gives immediate relief in the megrim;——why the ſight may be loſt by an injury done to the *ſupra orbitar* branch;—how it may be reſtored by agitation of that branch of this nerve.

The ſecond branch of the fifth pair of nerves

nerves may be called *MAXILLARIS SUPERIOR*, from its ſerving principally the parts of the upper jaw. It goes out at the round hole of the ſphenoid bone, and ſends immediately one branch into the channel on the top of the *antrum maxillare*; the membrane of which and the upper teeth are ſupplied by it in its paſſage. As this branch is about to go out at the *foramen orbitarium externum*, it ſends a nerve through the ſubſtance of the *os maxillare* to come out at *Steno's* duct to be diſtributed to the fore-part of the palate; and what remains of it eſcaping at the *external orbitar* hole, divides into a great many branches, that ſupply the cheek, upper lip, and noſtril.—The next conſiderable branch of the *ſuperior maxillary* nerve, after giving branches which are reflected through the ſixth hole of the *ſphenoid* bone, to join the intercoſtal where it is paſſing through the ſcull with the carotid artery, and the *portio dura* of the ſeventh pair, as it paſſes through the *os petroſum*, is ſent into the noſe by the hole common to the palate and ſphenoidal bone; and the remaining part of this nerve runs in the *palato-maxillaris* canal, giving off branches to the temples and pterygoid muſcles, and comes at laſt into the palate to be loſt.——Hence, the ach in the teeth of the upper jaw occaſions a gnawing pain deep ſeated in the bones of the face, with ſwelling in the eye-lids, cheek, noſe, and upper lip; and on the other hand, an inflammation in theſe parts, or a megrum, is often attended with ſharp pain in the teeth.—Hence, an obſtruction in the duct of the maxillary ſinus, which obliges the liquor ſecreted there to find

find out a preternatural rout for itself, may be occasioned by the pain of the teeth.——— Hence, the upper lip often suffers when the palate or nose is ulcerated.

The third or *MAXILLARIS INFERIOR* branch of the fifth pair going out at the oval hole of the sphenoid bone, serves the muscles of the lower jaw, and the muscles situated between the *os hyoides* and *jaw*: All the salivary glands; the *amygdalæ*, and the external ear, have branches from it: It has a large branch lost in the tongue, and sends another through the canal in the substance of the lower jaw to serve all the teeth there, and to come out at the hole in the fore-part of the jaw, to be lost in the chin and under lip.———Hence a convulsive contraction of the muscles of the lower jaw, or the mouth's being involuntarily shut, a great flow of spittle or salivation, a pain in the ear, especially in deglutition, and a swelling all about the throat, are natural consequences of a violent irritation of the nerves of the lower teeth in the toothach; and pain in the teeth and ear, is as natural a consequence of an *angina*.——— Hence alternate pressure on the chin may sometimes relieve the violence of a toothach.——— Hence destroying the nerves of a tooth by actual or potential cauteries, or pulling a carious tooth, so often removes immediately all these symptoms.———Hence no cure is to be found for some ulcers in the upper or lower jaw, but by drawing a tooth.———Hence in cancers of the upper lip, the salivary glands are in danger of being affected, or the disease

eaſe may be occaſioned to the lip by its beginning in the glands.— Perhaps the ſympathy of the organs of taſting and ſmelling may in ſome meaſure depend on their both receiving nerves from the fifth pair.

The *SIXTH PAIR*, which is the ſmalleſt except the fourth, riſes from the fore-part of the *corpora pyramidalia*; and each entering the *dura mater* ſome way behind the poſterior clinoid proceſs of the ſphenoid bone, has a long courſe below that membrane, and within the *receptaculum* at the ſide of the *ſella turcica*, where it is immerſed in the blood of the receptacle; but for what purpoſe I am ignorant. It goes afterwards out at the *foramen lacerum* into the orbit, to ſerve the abductor muſcle of the eye.— A defect in this nerve may therefore be one cauſe of a *ſtrabiſmus*.— In the paſſage of this nerve below the *dura mater*, it lies very contiguous to the internal carotid artery, and to the ophthalmic branch of the fifth pair of nerves. At the place where the ſixth pair is contiguous to the carotid, a nerve either goes from each of them in an uncommon way, to wit, with the angle beyond where it riſes obtuſe, to deſcend with the artery, and to form the beginning of the intercoſtal nerve, accordtng to the common deſcription; or, according to other authors, this nerve comes up from the great *ganglion* of the *intercoſtal*, to be joined to the ſixth here.

The arguments for this latter opinion are, That, according to the common doctrine, this beginning of the *intercoſtal* nerve, as it is called, would riſe in a manner not ſo ordinary in nerves. In the next place, it is obſerved, that the

the sixth pair is larger nearer to the orbit, than it is before it comes to the place where this nerve is said to go off; and therefore it is more probable, that it receives an addition there, rather than gives off a branch. *Lastly*, It is found, that upon cutting the *intercostal* nerves of living animals, the eyes plainly were affected; they lost their bright water; the gum, or gore, as we call it, was separated in greater quantity; the pupil was more contracted; the cartilaginous membrane, at the internal *canthus*, came more over the eye; and the eye-ball itself was diminished.

To this it is answered, in defence of the more common doctrine, 1*st*, That other branches of nerves go off in a reflected way, as well as this does, supposing it to be the beginning of the intercostal; and that the reflection would rather be greater, if it is thought to come up from the intercostal to the sixth. 2*dly*, It is denied that this nerve is for ordinary thicker at its fore than its back-part; and if it was supposed to be thickest nearer to the orbit, the conclusion made above could not be drawn from this appearance, because other nerves enlarge sometimes where there is no addition made to them, as in the instance already mentioned of the trunk of the fifth pair while below the *dura mater*. 3*dly*, The experiments on living animals shew indeed, that the eyes are affected, upon cutting the intercostal nerve, but not in the way which might have been expected, if the *intercostal* had furnished such a share of the nerve that goes to the *abductor* muscle of the eye; for it might have been thought, that this muscle would have been so much weakened immediately upon cutting the

intercostal, that its antagonist the *adductor* would have greatly prevailed over it, and have turned the eye strongly in towards the nose; which is not said to be a consequence of this experiment. So that the arguments are still equivocal; and more observations and experiments must be made, before it can be determined with certainty, whether the sixth pair gives or receives a branch here. In the mean time, I shall continue to speak about the origin of the *intercostal* with the generality of anatomists.

At this place where the intercostal begins, the fifth pair is contiguous and adherent to the sixth; and it is generally said, that the ophthalmic branch of the fifth gives a branch or two to the beginning of the intercostal, or receives such from it. Others deny any such communication between them; and those who affirm the communication confess, that in some subjects they could not see it. After examining the nerves here in a great many subjects, I cannot determine whether or not there are nervous filaments going from the one to the other. Sometimes I have thought that I traced them evidently: at other times I observed, that what I dissected for nervous filaments, was collapsed cellular substance; and in all the subjects where I had pushed an injection successfully into the very small arteries, I could only observe a *plexus* of vessels connecting the one to the other. In any of these ways, however, there is as much connection as we are assured from many experiments and observations on other nerves, is sufficient to make a very great sympathy among the nerves here.—Possibly the appearances in the eyes of dogs, whose intercostal nerves were cut, might be owing to this sympathy.

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The *SEVENTH PAIR* comes out from the lateral part of the *annular proceſs*, behind where the medullary proceſs of the *cerebellum* are joined to that *tuber*; and each being accompanied with a larger artery than moſt other nerves, enters the *internal meatus auditorius*, where the two large bundles of fibres, of which it appeared to conſiſt within the ſcull, ſoon ſeparate from each other; one of them entering by ſeveral ſmall holes into the *veſtible*, *cochlea*, and *ſemicircular canals*, is ſtretched on this inner *camera* of the ear in a very ſoft pulpy ſubſtance; and being never ſeen in the form of a firm cord, ſuch as the other parcel of this and moſt other nerves become, is called *PORTIO MOLLIS* of the auditory nerve.

The other part of this ſeventh pair paſſes through *Galen's foramen cæcum*, or *Fallopius's aqueduct*, in its crooked paſſage by the ſide of the *tympanum*; in which paſſage, a nerve ſent from the lingual branch of the inferior maxillary nerve, along the outſide of the *tuba Euſtachiana*, and croſs the cavity of the *tympanum*, where it has the name of *chordæ tympani*, is commonly ſaid to be joined to it. The very acute angle which this nerve makes with the fifth, or the ſudden violent reflection it would ſuffer on the ſuppoſition of its coming from the fifth to the ſeventh, appears unuſual: whereas, if we ſuppoſe that it comes from the ſeventh to the fifth, its courſe would be more in the ordinary way, and the *chordæ tympani* would be eſteemed a branch of the ſeventh pair going to join the fifth, the ſize of which is increaſed by this acquiſition. This ſmaller bundle of the ſeventh gives branches to the muſcles of

the *malleus*, and to the *dura mater*, while it paſſes through the bony crooked canal, and at laſt comes out in a firm chord named *PORTIO DURA*, at the end of this canal, between the *ſtyloid* and *maſtoid* proceſſes of the temporal bone, giving immediately filaments to the little oblique muſcles of the head and to thoſe that riſe from the ſtyloid proceſs. It then pierces through the parotid gland, and divides into a great many branches, which are diſperſed in the muſcles and teguments that cover all the ſide of the upper part of the neck, the whole face and *cranium*, as far back as the temples, including a conſiderable part of the external ear. Its branches having thus a conſiderable connection with all the three branches of the fifth pair, and with the ſecond cervical, occaſion a conſiderable ſympathy of theſe nerves with it.——Hence, in the toothach, the pain is ſometimes very little in the affected tooth, compared to what it is all along the ſide of the head and in the ear.——Hence probably the relief of the toothach from bliſters applied behind or before the ear, or by a hot iron touching the *antihelix* of the ear.—By this communication or connection poſſibly too it is, that a vibrating ſtring held between one's teeth, gives a ſtrong idea of ſound to the perſon who holds it, which no body elſe can perceive.—— Perhaps too the diſtribution of this nerve occaſions the head to be ſo quickly turned upon the impreſſion of ſound on our ears.

The *EIGHTH PAIR* of nerves riſe from the lateral baſes of the *corpora olivaria* in diſgregated fibres; and as they are entering the anterior internal part of the holes common to

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the *os occipitis* and *temporum*, each is joined by a nerve which ascends within the *dura mater* from the tenth of the head, the first, second and inferior cervical nerves: This every body knows has the name of the *NERVUS ACCESSORIUS*. When the two get out of the scull the *accessorius* separates from the eighth, and, descending obliquely outwards, passes through the *sterno mastoideus* muscle, to which it gives branches, and afterwards terminates in the *trapezius* and *rhomboid* muscles of the *scapula*. In this course it is generally more or less joined by the second cervical nerve.—Why this nerve, and several others which are distributed to muscles, are made to pierce thro' muscles, which they might have only passed near to, I do not know.

The large *eighth pair*, soon after its exit, gives nerves to the tongue, *larynx*, *pharynx*, and *ganglion* of the *intercostal* nerve, and being disjoined from the ninth and intercostal, to which it adheres closely some way, runs streight down the neck behind the internal jugular vein, and at the external side of the carotid artery. As it is about to enter the *thorax*, a large nerve goes off from the eighth of each side: This branch of the right-side turns round from the fore to the back part of the subclavian artery, while the branch of the left side turns round the great curve of the *aorta*, and both of them mounting up again at the side of the *œsophagus*, to which they give branches, are lost at last in the *larynx*. These are called the *RECURRENT* nerves, which we are desired to shun in the operation of *bronchotomy*, though their deep situation protects them sufficiently.—The muscles of the *larynx* being in a good measure supplied with nerves from

the recurrents, it is to be expected, that the cutting of them will greatly weaken the voice, tho' it will not be entirely loft, fo long as the fuperior branches of the eighth pair are entire. —— Why the recurrent nerves rife fo low from the eighth pair to go round a large artery, and to have fuch a long courfe upwards, I know not.

The eighth pair, above and at or near the place where the recurrent nerves go off from it, or frequently the recurrents themfelves, fend off fmall nerves to the *pericardium*, and to join with the branches of the intercoftal that are diftributed to the heart; but their fize and fituation are uncertain.

After thefe branches are fent off, the *par vagum* on each fide defcends behind the great branch of the *trachea*, and gives numerous filaments to the lungs, and fome to the heart in going to the *œfophagus*. The one of the left fide running on the fore part of the *œfophagus*, communicates by feveral branches with the right one in its defcent to be diftributed to the ftomach: The right one gets behind the *œfophagus*, where it fplits and rejoins feveral times before it arrives at the ftomach, to which it fends nerves; and then being joined by one or more branches from the left trunk, they run towards the cæliac artery, there to join into the great *femilunar ganglion* formed by the two intercoftals.

From the diftribution of this *par vagum*, we may learn how tickling the *fauces* with a feather or any fuch fubftance, excites a *naufea* and inclination to vomit;——why coughing occafions vomiting, or vomiting raifes a cough. ——Hence we fee how the nervous *afthma* and the *tuffis convulfiva*, chincough, are attended.

tended with a ſtraitening of the *glottis*;—why food difficult to digeſt occaſions the *aſthma* to weakly people; and why *emetics* have frequently cured the *aſthma* very ſpeedily.——why an attempt to vomit is ſometimes in danger of ſuffocating *aſthmatic* people;—why the ſuperior orifice of the ſtomach is ſo ſenſible, as to be looked on as the ſeat of the ſoul by ſome;———why people ſubject to diſtenſions of the ſtomach, have ſo often the ſenſation of balls in their breaſts and throats;———why the *globus hyſtericus* is ſo often attended with a violent ſtrangulation at the *glottis*.

The *NINTH PAIR* of nerves comes from the inferior part of the *corpora pyramidalia*, to go out of the ſcull at their proper holes of the occipital bone. After their egreſs they adhere for ſome way firmly to the eighth and intercoſtal; and then ſending a branch, that in many ſubjects is joined with branches of the firſt and ſecond cervical nerves, to be diſtributed to the thyroid gland and muſcles on the fore-part of the *trachea arteria*, the ninth is loſt in the muſcles and ſubſtance of the tongue. Some have thought this nerve, and others have eſteemed the third branch of the fifth pair of nerves, to be the proper guſtatory nerve. I know no obſervation or experiments to prove either opinion, or to aſſure us, hat both nerves do not ſerve for taſting and for the motion of the tongue. —May not the diſtribution of this nerve to the muſcles below as well as above the *os hyoides*, contribute to their acting more uniformly in depreſſing the lower jaw or head?

The *TENTH PAIR* riſes in ſeparate threads from the ſides of the *ſpinal marrow*, to go out between the *os occipitis* and *firſt vertebra*

tebra of the neck. After each of them has given branches to the great ganglion of the intercoſtal, 8th, 9th, and 1ſt cervical nerves, it is diſtributed to the ſtreight, oblique, and ſome of the extenſor muſcles of the head. Whether the name of the tenth of the head, or of the firſt vertebral, ought to be given to this pair of nerves, is of no ſuch conſequence as to deſerve a debate, tho' it has ſome of the marks of the ſpinal nerves, to wit, its being formed of filaments proceeding from both the fore and back part of the *medulla*, and a little *ganglion* being formed where theſe filaments meet.

In the deſcription of the ſixth pair, I followed the uſual way of ſpeaking among anatomiſts, and called that the beginning of the intercoſtal nerve which comes out of the ſcull; and therefore ſhall here ſubjoin a curſory deſcription of this nerve, notwithſtanding its much larger part is compoſed of nerves coming out from the *ſpinal marrow*. There is no greater incongruity in point of method to ſay, that the nerve we are deſcribing receives additions from others that have not been deſcribed, than it is to repeat in the deſcription of a great many nerves, that each of them gives branches to form a nerve which we are ignorant of; which is all the difference between deſcribing the intercoſtal before or after the ſpinal nerves.

The branch reflected from the ſixth pair, joined poſſibly by ſome filaments of the *opthalmic* branch of the fifth, runs along with the internal carotid artery, through the crooked canal formed for it in the *temporal bone*, where the little nerve is very ſoft and pappy, and in ſeveral ſubjects divides and unites again, and is joined by one or more branches from the fifth

fifth, particularly of its ſuperior maxillary branch, before it comes out of the ſcull. May the compreſſion of this nerve by the carotid artery when ſtretched during the *ſyſtole*, contribute to the *diaſtole* of the heart? As ſoon as the nerve eſcapes out of this bony canal, it is connected a little way with the eighth and ninth; then ſeparating from theſe, after ſeeming to receive additional nerves from them, it forms a large *ganglion*, into which branches from the tenth of the head, and from the firſt and ſecond cervical enter. From this ganglion the nerves come out again ſmall to run down the neck along with the carotid artery, communicating by branches with the cervical nerves, and giving nerves to the muſcles that bend the head and neck. As the *intercoſtal* is about to enter the *thorax*, it forms another ganglion, from which nerves are ſent to the *trachea* and to the heart; theſe deſigned for the heart joining with the branches of the eight, and moſt of them paſſing between the two great arteries and the auricles, to the ſubſtance of that muſcle. The intercoſtal after this conſiſting of two branches, one going behind, and the other running over the fore-part of the ſubclavian artery, forms a new ganglion where the two branches unite below that artery, and then deſcending along the ſides of the *vertebræ* of the *thorax*, receives branches from each of the dorſal nerves; which branches appearing to come out between the ribs, have given the name of intercoſtal to the whole nerve. Where the addition is made to it from the fifth dorſal nerve, a branch goes off obliquely forewards; which being joined by ſuch branch-

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es from the sixth, seventh, eight, and ninth dorsal, an anterior trunk is formed, and passes between the fibres of the *appendix musculosa* of the diaphragm, to form, along with the other intercostal and the branches of the eighth pair, a large semilunar ganglion, situated between the cœliac and superior mesenteric arteries; the roots of which are as it were involved in a sort of nervous net-work of this ganglion, from which a great number of very small nervous threads run out to be extended on the surface of all the branches of those two arteries, so as to be easily seen when any of the arteries are stretched, but not to be raised from them by dissection; and thus the *liver*, *gall-bladder*, *duodenum*, *pancreas*, *spleen*, *jejunum*, *ilium*, and a large share of the *colon*, have their nerves sent from this great *solar ganglion* or *plexus*.—May the peristaltic motion of the intestines depend in some measure on the passage of the intercostal nerves thro' the diaphragm?

Several fibres of this ganglion, running down upon the *aorta*, meet with other nerves sent from the posterior trunk of the intercostal which continues its course along the sides of the *vertebræ*, they supply the *glandulæ renales*, kidneys, and *testes* in men, or *ovaria* in women; and then they form a net-work upon the inferior mesenteric artery where the nerves of the two sides meet, and accompany the branches of this artery to the part of the *colon* that lies in the left side of the belly, and to the *rectum*, as far down as to the lower part of the *pelvis*.

The intercostal continuing down by the side of the *vertebræ* of the loins, is joined by nerves coming from between these *vertebræ*, and sends

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nerves to the organs of generation and others in the *pelvis*, being even joined with those that are sent to the inferior extremities.

The almost universal connection and communication which this nerve has with the other nerves of the body, may lead us to understand the following, and a great many more *phænomena*:—— Why tickling the nose causes sneezing.——Why the too great quantity of bile in the *cholera* occasions vomiting as well as purging.——— Why people vomit in colics, in inflammations, or other irritations of the liver, or of the ducts going from it and the gall-bladder.———Why a stone in the kidneys, or ureters, or any other cause irritating those organs, should so much more frequently bring on vomiting and other disorders of the stomach, than the stone, or any other stimulating cause in the bladder does.——Why vomiting is a symptom of danger after child birth, lithotomy, and other operations on the parts in the *pelvis*.——Why the obstructions of the *menses* are capable of occasioning strangulations, belching, colics, stomach-aches, and even convulsions in the extremities.—Why vesicatories, applied from the ears to the clavicles of children labouring under the *tussis convulsiva*, are frequently of great service.———Why worms in the stomach or guts excite an itching in the nose, or grinding of the teeth.——Why irritations in the bowels or the belly occasion sometimes universal convulsions of the body.

The *spinal* nerves rise generally by a number of disgregated fibres from both the fore and back part of the *medulla spinalis*, and soon after form a little knot or ganglion, where they acquire strong coats, and are extended into firm

firm cords. They are diſtinguiſhed by numbers, according to the *vertebræ* from between which they come out; the ſuperior of the two bones forming the hole through which they paſs, being the one from which the number is applied to each nerve. There are generally ſaid to be *thirty pair* of them; ſeven of which come out between the *vertebræ* of the *neck*, twelve between thoſe of the *back*, five between thoſe of the loins, and ſix from the *falſe vertebræ*.

The *FIRST CERVICAL* pair of nerves comes out between the firſt and ſecond *vertebræ* of the neck; and having given branches to join with the tenth pair of the head, the ſecond cervical and intercoſtal, and to ſerve the muſcles that bend the neck, it ſends its largeſt branches backwards to the extenſor muſcles of the head and neck; ſome of which piercing through theſe muſcles, run up on the *occiput* to be loſt in the teguments here; and many fibres of it advance ſo far foreward as to be connected with the *fibrils* of the firſt branch of the fifth pair of the head, and of the *portio dura* of the *auditory nerve*.——Hence poſſibly it is that a *clavus hyſtericus* changes ſuddenly ſometimes from the forehead to a violent pain and ſpaſm in the back-part of the head and neck.

The *SECOND CERVICAL* is ſoon joined by ſome branches to the ninth of the head and intercoſtal, and to the firſt and third of the neck; then has a large branch that comes out at the exterior edge of the *ſterno-maſtoideus* muſcle, where it joins with the *acceſſorius* of the eighth pair; and is afterwards diſtributed to the *platyſma myoides*, teguments of the ſide of the neck and head, parotid gland,

gland, and external ear, being connected to the *portio dura* of the auditory nerve, and to the first cervical. The remainder of this second cervical is spent on the *levator scapulæ* and the extensors of the neck and head. Generally a large branch is here sent off to join the *accessorius* of the eighth pair, near the superior angle of the *scapula*.

To the irritation of the branches of this nerve it probably is, that, in an inflammation of the parotid gland, the neck is pained so far down as the clavicle, the head is drawn towards the shoulder of the affected side, and the chin is turned to the other side.——In opening the external jugular vein, no operator can promise not to touch some of the cutaneous branches of this nerve with the lancet; which occasions a sharp pricking pain in the mean time, and a numbness of the skin near the orifice for some time after.

The *THIRD PAIR* of the neck passes out between the third and fourth cervical *vertebræ*; having immediately a communication with the second, and sending down a branch, which being joined by a branch from the fourth cervical, forms the *PHRENIC* nerve. This descending enters the *thorax* between the subclavian vein and artery; and then being received into a groove formed for it in the *pericardium*, it has its course along this *capsula* of the heart, till it is lost in the middle part of the diaphragm. The right phrenic has a streight course; but the left one is obliged to make a considerable turn outwards to go over the prominent part of the *pericardium*, where the point of the heart is lodged. Hence in violent palpitations of the

heart, a pungent acute pain is felt near the left orifice of the ſtomach.—The middle of the diaphragm ſcarce could have been ſupplied by any other nerve which could have had ſuch a ſtreight courſe as the *phrenic* has. If the ſubclavian artery and vein have any effect upon this nerve, I do not know it.

The other branches of the third cervical nerve are diſtributed to the muſcles and teguments at the lower part of the neck and top of the ſhoulder. No wonder then that an inflammation of the liver or ſpleen, an abſceſs in the lungs adhering to the diaphragm, or any other cauſe capable of irritating the diaphragm, ſhould be attended with a ſharp pain on the top of the ſhoulder, as well as wounds, ulcers, &c. of this muſcle itſelf.——If the irritation of this muſcle is very violent, it may occaſion that convulſive contraction of the diaphragm which is called an *hiccough*; and therefore an hiccough in an inflammation of the liver has been juſtly declared to be an ill ſymptom.

An irritation of the thoracic nerves which produces ſneezing, may ſometimes free the phrenic nerves from any ſpaſm they occaſion; ſo that ſneezing ſometimes takes away the hiccough; and a derivation of the fluid of the nerves any other way may do the ſame thing: Or the hiccough may alſo be ſometimes cured, by drawing up into the noſe the ſmoak of burning paper or other acrid fumes, ſwallowing pungent or aromatic medicines, and by a ſurpriſe, or any other ſtrong application of the mind in thinking, or in diſtinguiſhing objects: Or, when all theſe have failed, it has been put away by the briſk *ſtimulus* of a bliſtering plaiſter applied to the back.

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The *FOURTH CERVICAL* nerve, after ſending off that branch which joins with the third to form the phrenic, and beſtowing twigs on the muſcles, and glands of the neck, runs to the arm-pit, where it meets with the *FIFTH*, *SIXTH*, and *SEVENTH* cervicals, and *FIRST DORSAL*, that eſcape in the interſtices of the *muſculi ſcaleni*, to come at the arm pit, where they join, ſeparate, and rejoin, in a way ſcarce to be rightly expreſſed in words; and, after giving ſeveral conſiderable nerves to the muſcles and teguments which cover the *thorax*, they divide into ſeveral branches, to be diſtributed to all the parts of the ſuperior extremity. Seven of theſe branches I ſhall deſcribe under particular names.

1. *SCAPULARIS* runs ſtreight to the *cavitas ſemilunata* of the upper *coſta* of the *ſcapula*, which is a hole in the recent ſubject by a ligament being extended from one angle of the bone to the other, giving nerves in its way to the muſcles of the *ſcapula*. When it has paſſed this hole, it ſupplies the *ſupra ſpinatus* muſcle; and then deſcending at the anterior root of the *ſpine* of the *ſcapula*, it is loſt in the other muſcles that lie on the *dorſum* of that bone.

2. *ARTICULARIS* ſinks downwards at the *axilla*, to get below the neck of the head of the *os humeri*, and to mount again at the back-part of it; ſo that it almoſt ſurrounds the articulation, and is diſtributed to the muſcles that draw the arm back, and to thoſe that raiſe it up.

3. *CUTANEUS* runs down the fore-part of the arm near the ſkin, to which it gives off branches; and then divides on the inſide of the fore-arm into ſeveral nerves, which ſupply

the teguments there, and on the palm of the hand.——In opening the basilic vein of the arm, at the ordinary place, the same symptoms are sometimes produced as in opening the external jugular vein, and from a like cause, to wit, from hurting a branch of this cutaneous nerve with the lancet.

4. *MUSCULO-CUTANEUS*, or *perforans Casseri*, passes through the *coracobrachialis* muscle; and after supplying the *biceps flexor cubiti* and *brachiœus internus*, passes behind the tendon of the *biceps*, and over the cephalic vein, to be bestowed on the teguments on the outside of the fore arm and back of the hand.——This nerve is sometimes hurt in opening the cephalic vein, and causes pain and numbness for a short time.

5. *MUSCULARIS* has a spiral course from the *axilla*, under the *os humeri*, and backward to the external part of that bone, supplying by the way the extensor muscles of the fore-arm, to which it runs between the two *brachiœi* muscles, and within the *supinator radii longus*.—At the upper part of the fore-arm, it sends off a branch, which accompanies the *supinator longus* till it comes near the wrist, where it passes obliquely over the *radius*, to be lost in the back of the hand and fingers.—The principal part of this nerve pierces through the *supinator radii brevis*, to serve the muscles that extend the hand and fingers, whose actions are not injured when the *supinator* acts.

6. *ULNARIS* is extended along the inside of the arm, to give nerves to the muscles that extend the fore-arm and to the teguments of the elbow: Towards the lower part of

of the arm, it ſlants a little backward to come at the groove behind the internal condyle of the *os humeri*, through which it runs to the *ulna*: In its courſe along this bone, it ſerves the neighbouring muſcles and teguments; and as it comes near the wriſt, it detaches a branch obliquely over the *ulna* to the back of the hand, to be loſt in the convex part of ſeveral fingers. The larger part of the nerve goes ſtreight foreward to the internal ſide of the *os piſiforme* of the wriſt; where it ſends off a branch which ſinks under the large tendons in the palm, to go croſs to the other ſide of the wriſt, ſerving the *muſculi lumbricales* and *interoſſei*, and at laſt terminating in the ſhort muſcles of the thumb and fore-finger. What remains of the ulnar nerve after ſupplying the ſhort muſcles of the little finger, divides into three branches; whereof two are extended along the ſides of the ſheath of the tendons of the flexors of the little finger, to furniſh the concave ſide of that finger; and the third branch is diſpoſed in the ſame way upon the ſide of the ring-finger next to the little finger.

When we lean or preſs on the internal condyle of the *os humeri*, the numbneſs and prickling we frequently feel, point out the courſe of this nerve. I have ſeen a weakneſs and atrophy in the parts which I mentioned this nerve to be ſent to, after a wound in the internal lower part of the arm.

7. *RADIALIS* accompanies the humeral artery to the bending of the elbow, ſerving the flexors of the cubit in its way; then paſſing through the *pronator radii teres* muſcle, it gives nerves to the muſcles on the fore-part of the fore-arm, and continues its courſe near

to the *radius*, beſtowing branches on the circumjacent muſcles. Near the wriſt, it ſometimes gives off a nerve which is diſtributed to the back of the hand, and the convex part of the thumb and ſeveral of the fingers, inſtead of the branch of the muſcular. The larger part of this nerve, paſſing behind the annular ligament of the wriſt, gives nerves to the ſhort muſcles of the thumb; and afterwards ſends a branch along each ſide of the ſheath of the tendons of the flexors of the thumb, fore-finger, mid-finger, and one branch to the ſide of the ring finger, next to the middle one, to be loſt on the concave ſide of thoſe fingers.

Though the *radial* nerve paſſes through the *pronator* muſcle, and the *muſcular* nerve ſeems to be ſtill more unfavourably placed within the *ſupinator brevis*; yet the action of theſe muſcles don't ſeem to have any effect in hindering the influence of theſe nerves, for the fingers or hand can be bended while pronation is performing vigorouſly, and they can be extended while ſupination is exerciſed.

The manner of the going off of theſe nerves of the fingers, both from the *ulnar* and *radial*, is, that a ſingle branch is ſent from the trunk to the ſide of the thumb and little finger fartheſt from the other fingers; and all the reſt are ſupplied by a trunk of a nerve, which ſplits into two ſome way before it comes as far as the end of the *metacarpus*, to run along the ſides of different fingers that are neareſt to each other.

It might have been obſerved, that, in deſcribing the poſterior branches of the *ulnar* and *muſcular nerve*, I did not mention the particular fingers, to the convex part of which they are diſtributed. My reaſon for this omiſſion is, the

the uncertainty of their diſtribution; for tho' ſometimes theſe poſterior branches go to the ſame fingers, to the concave part of which the anterior branches of the *ulnar* and *radial* are ſent, yet frequently they are diſtributed otherwiſe.

The ſituation of theſe brachial nerves in the *axilla*, may let us ſee, how a weakneſs and atrophy may be brought on the arms by long continued preſſure of crutches, or ſuch other hard ſubſtances on this part; and the courſe of them from the neck to the arm may teach us, how much better effects veſicatories, or ſtimulating nervous medicines, would have, when applied to the ſkin, covering the tranſverſe proceſſes of the *vertebræ* of the neck, or at the *axilla*, than when they are put between the ſhoulders, or upon the ſpinal proceſſes, in convulſions or palſies of the ſuperior extremities, where a *ſtimulus* is required.

The *TWELVE DORSAL* nerves of each ſide, as ſoon as they eſcape from between the *vertebræ*, ſend a branch foreward to join the intercoſtal, by which a communication is made among them all; and they ſoon likewiſe give branches backwards to the muſcles that raiſe the trunk of the body, their principal trunk being extended outwards to come at the furrow in the lower edge of each rib, in which they run toward the anterior part of the *thorax*, between the internal and external intercoſtal muſcles, giving off branches in their courſe to the muſcles and teguments of the *thorax*.

The *FIRST* dorſal, as was already obſerved, is particular in this, that it contributes to form the brachial nerves; and that the two branches of the intercoſtal, which come down to the *thorax*, form a conſiderable ganglion with it.

The

The *SIX* lower dorſal nerves give branches to the diaphragm and abdominal muſcles.

The *TWELFTH* joins with the firſt lumbar, and beſtows nerves on the *muſculus quadratus lumborum* and *iliacus internus*.

May not the communications of all theſe nerves be one reaſon, why the parts they ſerve act ſo uniformly and conjunctly in reſpiration, and conſpire together in the convulſive motions of coughing, ſneezing, *&c.?*——The twiching ſpaſms that happen ſometimes in different parts of the muſcles of the *abdomen*, by an irritation on the branches of the lower dorſal nerves, are in danger of occaſioning a miſtake in practice, by their reſemblance to the colick, *nephritis*, *&c.*—The communications of theſe lower ones with the intercoſtals may ſerve to explain the violent effort of the abdominal muſcles in a *teneſmus* and in child bearing.

As the intercoſtal is larger in the *thorax* than any where elſe, and ſeems to diminiſh gradually as it aſcends and deſcends, there is cauſe to ſuſpect that this is the trunk from which the ſuperior and inferior pairs are ſent as branches.

The *FIVE LUMBAR* nerves on each ſide communicate with the intercoſtal and with each other, and give branches backwards to the loins.

The *FIRST* communicates with the laſt dorſal, ſends branches to the abdominal muſcles, to the *pſoas* and *iliacus*, and to the teguments and muſcles on the fore-part of the thigh; while its principal branch joins with the other nerves, to form the crural nerve.

The *SECOND LUMBAR* nerve paſſes through the *pſoas muſcle*, and is diſtributed nearly in the ſame way as the former; as is alſo the *THIRD*.

Branches

Branches of the *second*, *third*, and *fourth*, make up one trunk, which runs along the fore-part of the *pelvis*; and paſſing in the notch at the fore-part of the great hole common to the *os pubis* and *iſchium*, is ſpent on the *adductor* muſcles, and on the teguments on the inſide of the thigh. This nerve is called the *OBTURATOR* or *POSTERIOR CRURAL NERVE*.

By united branches from the *firſt*, *ſecond*, *third*, and *fourth* lumbar nerves, a nerve is formed that runs along the *pſoas* muſcle, to eſcape with the external iliac veſſels out of the *abdomen*, below the tendinous arcade of the external oblique muſcle. This nerve, which is named the *ANTERIOR CRURAL*, is diſtributed principally to the muſcles and teguments on the fore-part of the thigh. A branch, however, of this nerve runs down the inſide of the leg to the upper-part of the foot, keeping near to the *vena ſaphæna*; in opening of which with a lancet at the ancle, the nerve is ſometimes hurt, and occaſions ſharp pain at the time of the operation, and numbneſs afterwards.

The remainder of the fourth lumbar and the fifth join in compoſing the largeſt nerve of the body; which is ſoon to be deſcribed.

Whoever attends to the courſe of theſe lumbar nerves, and of the ſpermatic veſſels and nerves upon the *pſoas* muſcle, with the oblique paſſage of the *ureter* over that muſcle, will not be ſurprized, that when a ſtone is paſſing in this canal, or even when it is inflamed, the trunk of the body cannot be raiſed erect, without great pain; or that the ſkin of the thigh becomes leſs ſenſible, and the thigh is drawn foreward, and

that

that the teſticle often ſwells and is drawn convulſively towards the ring of the abdominal muſcles.

The *SIXTH PAIR* of the falſe *VERTEBRÆ* conſiſt each of ſmall poſterior branches ſent to the hips, and of large anterior branches.

The *firſt*, *ſecond*, and *third*, after coming through the three upper holes in the fore-part of the *os ſacrum*, join together with the fourth and fifth of the loins, to form the largeſt nerve of the body, which is well known by the name of *SCIATIC* or *ISCHIATIC* nerve: This, after ſending large nerves to the different parts of the *pelvis*, and to the external parts of generation and the *podex*, as alſo to the muſcles of the hips, paſſes behind the great *tuber* of the *os iſchium*, and then over the *quadrigemini* muſcles to run down near to the bone of the thigh at its back-part, giving off nerves to the neighbouring muſcles and teguments. Some way above the ham, where it has the name of the *poplitæus* nerve, it ſends off a large branch that paſſes over the *fibula*, and ſinking in among the muſcles on the anterior external part of the leg, runs down to the foot, to be loſt in the upper part of the larger toes, ſupplying the neighbouring muſcles and teguments every where in its paſſage. The larger branch of the *ſciatic*, after giving branches to the muſcles and teguments about the ham and knee, and ſending a large cutaneous nerve down the calf of the leg, to be loſt at laſt on the outſide of the foot and upper part of the leſſer toes, ſinks below the *gemellus* muſcle, and diſtributes nerves to the muſcles on the back of the leg; among which it continues its courſe, till paſſing behind the internal

internal *malleolus*, and in the internal hollow of the *os calcis*, it divides into the two plantar nerves: The internal of which is distributed to the toes in the same manner that the *radial* nerve of the hand serves the concave side of the thumb and fingers; and the external *plantar* is divided and distributed to the sole of the foot and toes, nearly as the *ulnar* nerve is in the palm of the hand, and in the concave part of the fingers.

Several branches of these nerves, that serve the *inferior extremities*, pierce through muscles.

By applying what was said of the nerves in general to the particular distribution of the nerves of the *inferior extremities*, we may see how people with fractured legs, especially where there are splinters, should be subject to convulsive startings of the fractured member.——Why, upon tying the blood vessels in an amputation of the leg, the patients should sometimes complain of violent pain in their toes;——why such patients should also be troubled with startings;——why, for a considerable time after the amputation of the diseased limb, when the suppuration is well advanced, they should complain of pain in the sore which occasioned the amputation.

The *FOURTH*, which, with the two following, is much smaller than the three superior, soon is lost in the *vesica urinaria* and *intestinum rectum*.

The *FIFTH* comes foreward between the extremity of the *os sacrum* and *coccygis*, to be distributed principally to the *levatores ani*.

The *SIXTH*, which some think to be only a production of the *dura mater*, advances foreward below the broad shoulders of the first

bone

bone of the *os coccygis*, and is loſt in the *ſphincter ani* and teguments covering it.

The branches of the four laſt cervical nerves, and of the firſt dorſal, which are beſtowed on the *ſuperior extremities*, and the two crurals, with the ſciatic, which are diſtributed to the *inferior extremities*, are much larger proportionally to the parts they ſerve, than the nerves of the trunk of the body, and eſpecially of the *viſcera*, are; and for a very good reaſon, that in the moſt common neceſſary actions of life, a ſufficient quantity of fluid, on which the influence of nerves ſeems to depend, may be ſupplied to the muſcles there, which are obliged to perform more frequent and violent contractions than any other parts do. ——The ſize of the nerves of the *inferior extremities* ſeems larger proportionally than in the *ſuperior extremities*; the *inferior extremities* having the weight of the whole body to ſuſtain, and that frequently at a great diſadvantage——What the effect is of the nerves here being injured, we ſee daily, when people happen, by ſitting wrong, to compreſs the ſciatic nerve, they are incapable for ſome time after to ſupport themſelves on the affected *extremity:* And this is ſtill more remarkable in the *ſciatic* or *hip-gout*, in which the member is not only weakened, but gradually ſhrivels and waſtes.

The

THE

DESCRIPTION

Of the HUMAN

LACTEAL SAC AND DUCT.

THE *receptaculum chyli* of *Pecquet*, or *faccus lacteus* of *Van Horne*, is a membranous ſomewhat pyriform bag, two thirds of an inch long, one third of an inch over in its largeſt part when collapſed; ſituated on the firſt *vertebra* of the loins to the right of the *aorta*, a little higher than the right emulgent artery, behind the right inferior muſcle of the diaphragm: It is formed by the union of three tubes, one from under the *aorta*, the ſecond from the interſtice of the *aorta* and *cava*, the third from under the emulgents of the right ſide. The *lacteal ſac*, becoming gradually ſmaller towards its upper part, is contracted into a ſlender membranous pipe, of about a line diameter, which is generally named the

THORACIC DUCT. This paſſes betwixt the muſcular *appendices* or inferior muſcles of the diaphragm, on the right of, and ſomewhat behind the *aorta*; then, being lodged in the cellular ſubſtance behind the *pleura*, it mounts between the *aorta* and the *vena azygos* as far as the fifth *vertebra* of the *thorax*, where it is hid by the *azygos*, as this vein riſes forewards to join the deſcending or ſuperior *cava*; after which the duct paſſes obliquely over to the left ſide behind the *œſophagus*, *aorta deſcendens*, and the great curvature of the *aorta*, until it reaches the left carotid artery; behind which, on the left ſide of the *œſophagus*, it runs to the interſtice of the firſt and ſecond *vertebra* of the *thorax*, where it begins to ſeparate from the carotid, ſtretching farther towards the left internal jugular vein by a circular turn, whoſe convex part is uppermoſt. At the top of this arch it ſplits into two for a line and an half; the ſuperior branch receiving into it a large lymphatic veſſel from the cervical glands. This lymphatic appears, by blowing air and injecting liquors into it, to have few valves. When the two branches are again united, the duct continues its courſe towards the internal jugular vein, behind which it deſcends, and, immediately at the left ſide of the inſertion of this vein, enters the ſuperior poſterior part of the left ſubclavian vein, whoſe internal membrane duplicated, forms a ſemilunar valve that is convex externally, and covers two thirds of the orifice of the duct; immediately below this orifice, a cervical vein from the *muſculi ſcaleni*, enters the ſubclavian.

The

The coats of the *ſac* and *duct* are thin tranſparent membranes; from the inſide of which, in the duct, ſmall ſemilunar valves are produced moſt commonly in pairs; which are ſo ſituated as to allow the paſſage of liquors upwards, but oppoſe their return in an oppoſite courſe. The number of theſe is generally ten or twelve.

This is the moſt ſimple and common courſe, ſituation, and ſtructure of the *receptaculum chyli* and *thoracic duct*; but having had occaſion to obſerve a variety in theſe parts, of different ſubjects, I ſhall ſet down the moſt remarkable of them.

The ſac is ſometimes ſituated lower down than in the former deſcription; is not always of the ſame dimenſions; is not compoſed of the ſame number of ducts; and frequently appears to conſiſt of ſeveral ſmall cells or ducts, inſtead of being one ſimple cavity.

The diameter of the duct is various in moſt bodies, and is ſeldom uniform in the ſame ſubject; but frequently ſudden enlargements or *ſacculi* of it are obſervable. ——— The diviſions which authors mention of this duct are very uncertain. I have ſeen it divided into two, whereof one branch climbed over the fore-part of the *aorta* at the eighth *vertebra* of the *thorax*, and at the fifth ſlipped behind that artery, to join the other branch which continued in the ordinary courſe. ——— The preciſe *vertebra*, where it begins to turn to the left ſide, is alſo uncertain. ——— Frequently it does not ſplit at its ſuperior arch; in which caſe a large ſac is found near its aperture into the ſubclavian vein.—Generally it has but one orifice; though

though I have seen two in one body, and three in another: Nay, sometimes it divides into two, under the curvature of the great artery; one goes to the right, another to the left subclavian vein; and I have found this duct discharging itself entirely into the right subclavian.——The lymphatic vessel which enters its superior arch, is often sent from the *thyroid* gland.

Whether is not the situation of the *receptaculum chyli* so much nearer the muscular *appendices* of the diaphragm in men than in brutes, designed to supply the disadvantageous course the chyle must otherwise have in our erect posture?

Does not the descent of the end of the duct to the subclavian vein, and the opening of the lymphatic into the top of the arch, contribute to the ready admission of the chyle into that vein?

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